ELECTRICAL REVIEW

FOUNDED 1872

Vol. CXXVIII. No. 3285 NOVEMBER 8, 1940 SIXPENCE

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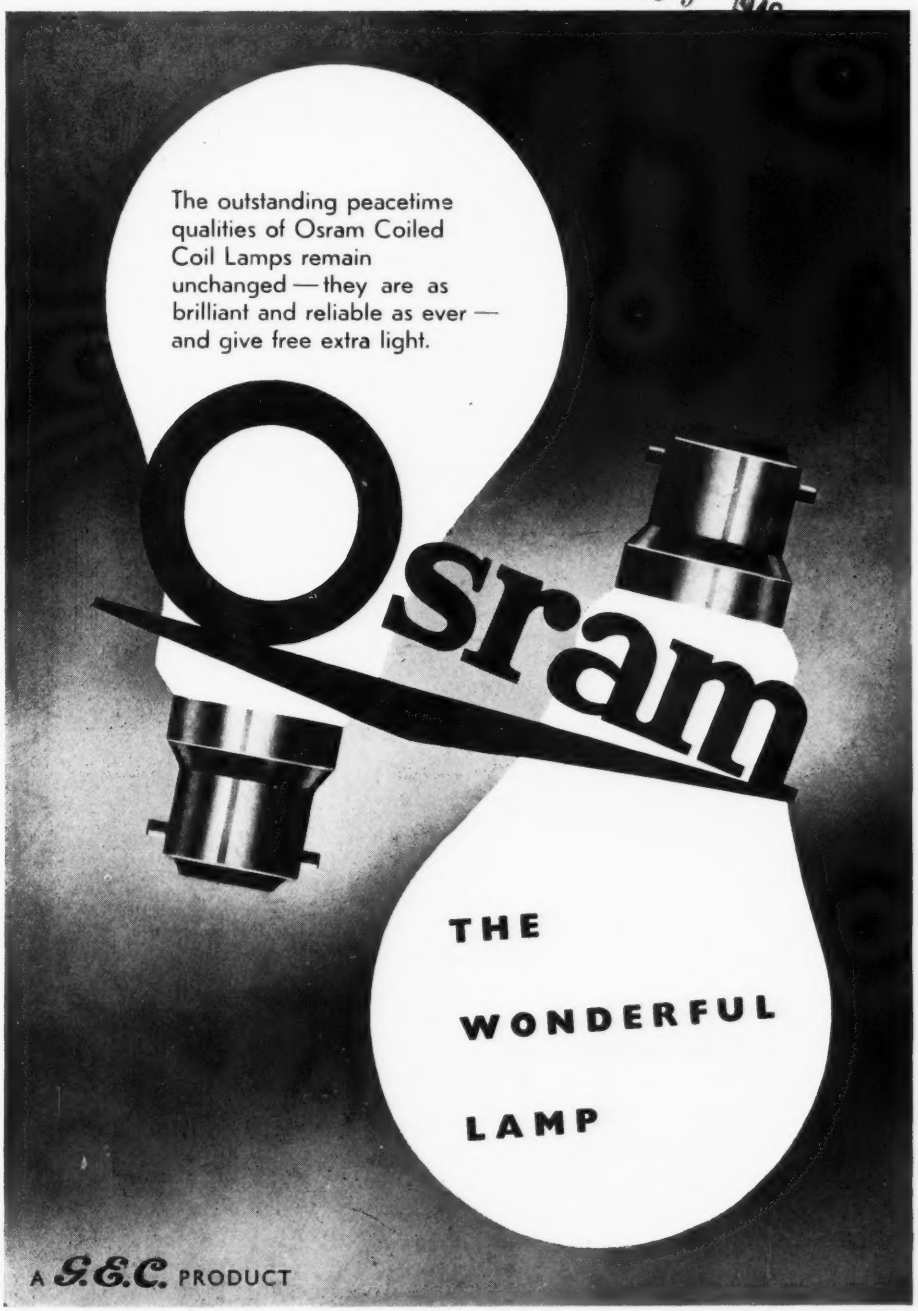
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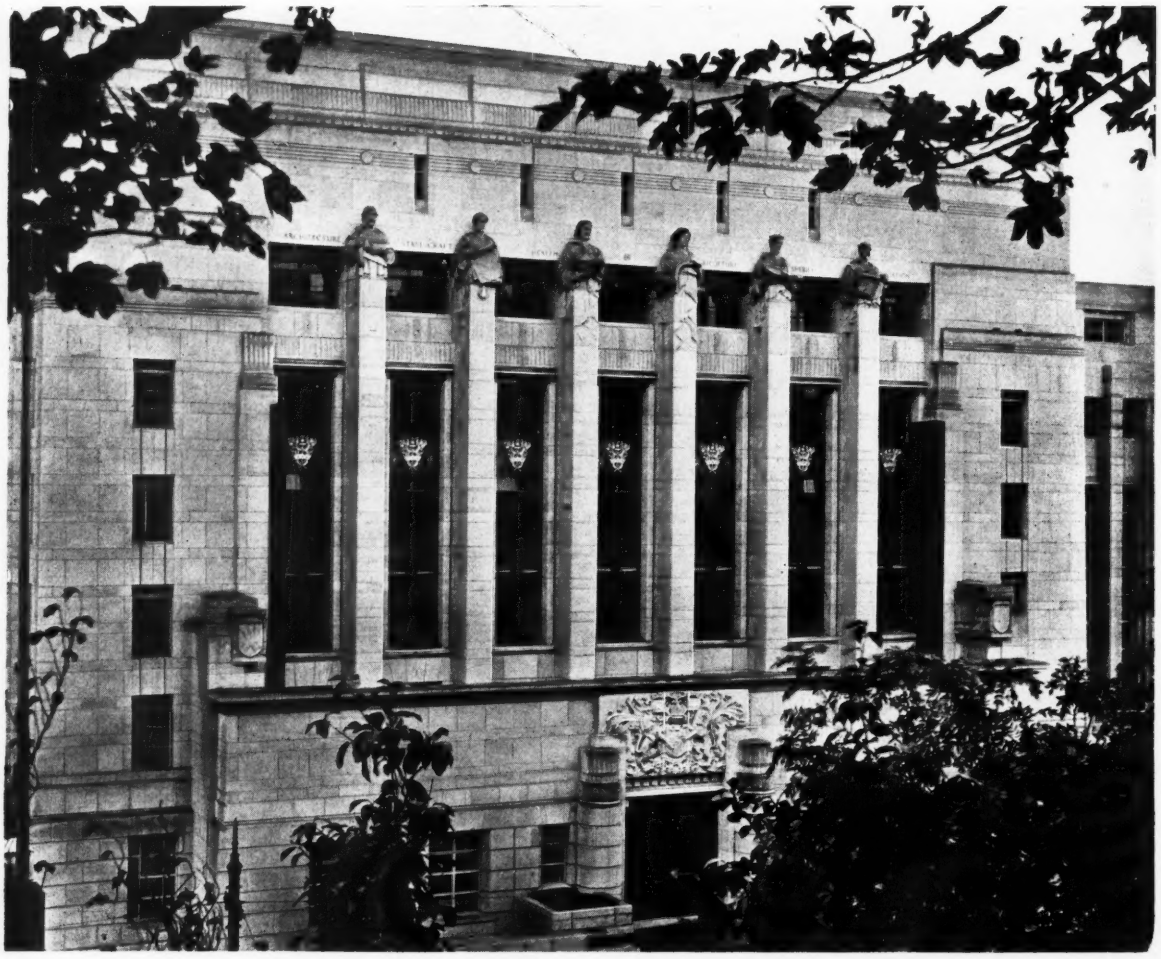

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THE ELECTRICAL REVIEW

Volume CXXVIII — No. 3285

Friday, November 8th, 1940

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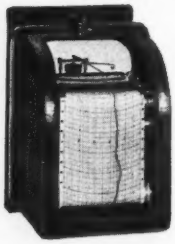

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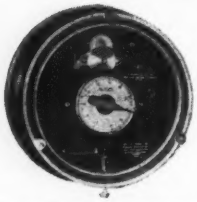

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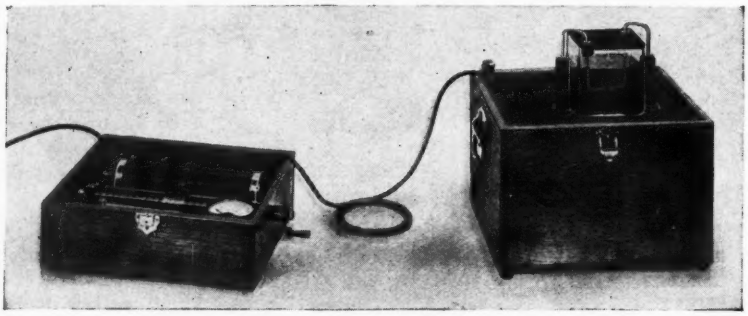

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THE
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THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXXVIII. No. 3285 NOVEMBER 8, 1940 Price SIXPENCE

Mutual Aid

Wartime Electrical Co-operation

IN few industries are relations between members so fundamentally friendly as in the electrical industry. In saying this we are not ignoring the wide divergencies of views which frequently exist; but behind these differences there is always a comradeship which becomes prominent in time of trouble.

The industry's first consideration to-day, as always, is to maintain the supply of energy. Aerial bombardment has added considerable difficulty and danger to this work, but in spite of all there have been practically no interruptions lasting for more than a few hours. This has been due principally to the existence of the grid which has proved its value when stations or sets have been put out of action temporarily.

But so far as distribution is concerned, the restoration of supply has been speeded up by the co-operative action of neighbouring undertakings and the Central Electricity Board who have promptly rushed men and equipment to the scene of trouble. Some of this assistance has been improvised but in many cases it has represented the execution of plans worked out in advance by groups of undertakings. It is to be hoped that the lessons thus learned will be taken to heart by other authorities who have not yet formulated mutual-aid schemes.

Contractors' Help

In several districts the local electrical contractors have lent a hand in the work. Among their employees are many men capable of repairing cable damage and handling distribution equipment. These have been called upon by the supply authorities in time of trouble under previously-arranged plans. In Lancashire, particularly, there has been close co-operation between the supply engineers and contractors, a contact which was most desirable in peacetime but not too often achieved. It apparently needs adversity to bring them together.

Another form of assistance in emergency has been instituted by groups of industrialists—notably in the North-East Coast area. This aims at continuity of production after damage to plant by air attack and it provides for a pool of motors and other equipment from which those affected may draw, a practical form of mutual insurance which is of far greater value than a monetary scheme.

All the arrangements mentioned are designed to meet damage caused by enemy action but this is not the only war handicap which has to be surmounted. The absolute necessity for concentration upon production for war purposes leads to a scarcity of equipment for purely civil use. This is felt especially in the domestic field which, although important, perforce has to take a secondary place in wartime. But although the manufacture of domestic appliances has had to be severely curtailed there are still large quantities of them available. All that is needed is a rearrangement of their distribution. In the stores of evacuated areas are numbers of cookers, washboilers and other appliances—both new and used—which are not now required, while in the areas to which people have been moved there is a shortage.

Stocks of Apparatus

The Incorporated Municipal Electrical Association is endeavouring to square up the situation to some extent by arranging the transfer of hire-purchase agreements when consumers move from one area to another, but this will affect only a small part of the business. More should be accomplished by the register which is being compiled by the British Electrical Development Association of apparatus surplus to requirements held by member undertakings.

But apart from electricity supply authorities' stocks a good deal of equipment remains in the stores and shops of electrical wholesalers and retailers, most of whom would welcome assistance in moving them in these days when people are unable or unwilling to pay cash down. This led Mr. V. W. Dale in a recent issue of the ELECTRICAL REVIEW to propose that a "census" should be carried out as a first step to putting these appliances into use instead of allowing them to depreciate in stock. We should like to see the suggestion adopted by the industry; it seems to be a matter which could be handled by the I.M.E.A.-E.C.A. Joint Committee with assistance from the Electrical Wholesalers' Federation. Between them they might set up

an effective clearing organisation to accomplish the redistribution to their own and the consumers' benefit. Incidentally, such a plan would seem to imply a continuation of supply authorities' hire-purchase schemes. Although this has been recommended by E.D.A., many undertakings have curtailed or discontinued hire-purchase. If appliances are made available and suitable safeguards are provided there is no reason why hire-purchase schemes should not be maintained as far as possible. It has been proved over and over again in the past year or so that among all sections there exists a desire to help. All that they need is inspiration and guidance which existing associations are competent to provide.

A Change of Size

READERS may have received a mild shock when they got their ELECTRICAL REVIEW this week and found it to be shorter than usual. The change has been found necessary to expedite printing, as well as to save a certain amount of paper, but there has been no curtailment of the amount of matter included in the editorial pages, taken as a whole. We have no doubt that our readers will rapidly become accustomed to the new format. The current issue, it will be noticed, starts a new volume.

Appliance Approval

THE "proving house" idea has again been raised recently in our columns, due to the number of accidents which have occurred in air-raid shelters. While most of these seem to have been attributable to faulty wiring, many have been caused by defective or shoddy apparatus. This has led to a revival of the proposal that no electrical apparatus should be sold until it had received the approval of a competent testing authority. Such bodies already exist in some of the Dominions. The arrangements in Canada, originally confined to the Province of Ontario, have been extended to cover the whole of the Dominion, and apparatus for domestic use must now bear an approval mark. In New South Wales a reminder of the existence of similar arrangements is given by a report of the prosecution of a Sydney firm for offering for sale an electric radiator and handlamps which had not received official approval. The New South Wales scheme covers practically the whole range of domestic appliances, including small wiring accessories, but, strangely enough, a list given by the Australian *Merchandiser* does not include cookers, although grillers are mentioned.

Power in Australia

NEARLY 84 per cent. of the 1,061,000 HP of electric motors officially recorded as installed in Australia in 1937-38 were supplied from the public mains. There are no strictly comparable figures available for Great Britain and, most unfortunately, details of power equipment at factories were not required to be furnished in the last Board of Trade Census of Production (1935). From figures of consumption given for various trades in the eighteenth annual report of the Electricity Commissioners, however, Australian supply undertakings would appear to be very much ahead of those at home in this respect, if the plant load factor is at all similar for electricity provided from public and private generation. These figures showed that in 1935 only about 53 per cent. of industrial power was produced by public supply stations in this country. Although, no doubt, the proportion is higher to-day, even apart from war conditions, the Australian results provide something to emulate.

Warming Shelters

AIR-RAID shelters in which one can take refuge from shrapnel and splinters for brief periods are one thing; it is quite another matter to provide accommodation at night for those who want to sleep in quiet and relative security. The latter need to be lighted, ventilated and, with the colder weather approaching, heated also—all matters for which electricity is essential. Fortunately, electricity is the most reliable agent, as recent events have shown and, for lighting, batteries can be installed as a standby in accordance with the requirements of the relevant B.S. Specifications. For heating, a favourable opportunity is offered to the low-temperature system to prove its merits. Apart from the reduction in fire risk that it makes possible, the heaters could be switched out for short peak periods should local loading conditions make this desirable. It is of the first importance that a place intended for safety should not be rendered less safe through faulty installation practice, and the principles set out in Mr. J. J. Lesser's article in our issue of September 6th should be carefully observed.

Unhelpful Advice

THE warning regarding amateur electrical installations in air-raid shelters recently issued by the Electrical Development Association has had an extraordinarily good "press." We have seen it quoted in local newspapers from all parts of the country. Apparently it has not reached as far as Goole for a newspaper published in that town says: "Not only hot water bottles, but radiators will be needed in the shelters this winter. Get some yards of extra flex and run the small electric radiator into the shelter from the house plug. This can also be done with the electric light." It is pleasing to be able to report, however, that our contemporary adds a word of caution: "Remove any inflammable substance from the vicinity of the radiator."

Fluorescent Lamps

DEPRECATING the idea that to encourage the use of small fluorescent lamps would be to reduce lighting consumption, Mr. J. W. Koehler, writing in *Electrical News & Engineering* (Toronto) mentions a point about these lamps which seems likely to improve matters from the supply undertakings' point of view. The near approach of "daylight" fluorescent lamps to natural light has, he has found, the effect of making 20 ft.-candles appear rather dim, so that the user calls for 30 to 50 ft.-candles instead. Also, in warm weather there is not the same tendency to switch off such lamps since the light appears cooler. With regard to the general question, experience of some thirty years ago when the tungsten filament superseded the carbon-filament lamp shows that fears then expressed regarding possible loss of revenue were groundless. The public preferred better lighting to reduced wattage.

MEASUREMENT OF THICKNESS

Electrical Apparatus for Accurate Determination

ACCURATE measurement of the thickness of materials, or bore of component parts, has become a specific part of engineering practice. The refinement of determination achieved by the adoption of electrical principles has been of conspicuous service in the perfection of improved gauges of many types. For instance, the electrical evaluation of mechanical gauge measurements is being largely employed in precision engineering. The principle usually adopted is simple and depends upon the use of an armature which splits the air gap in a double inductance coil, the displacement of which increases the gap associated with one of the coils and reduces the gap associated with the other. The two coils form opposite arms of a bridge circuit.

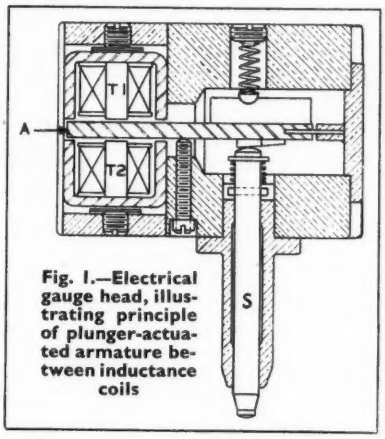


Fig. 1.—Electrical gauge head, illustrating principle of plunger-actuated armature between inductance coils

In 1937 Frobose described a gauge with a feeler which determines the position of an armature moving between two electro-magnets, AC being passed through the windings, the inductance of which is thus affected so as to alter the deflection of a galvanometer in the bridge circuit. This was stated to measure a range of $\pm$ 10μ (0.0004 in.) The magnification from feeler to galvanometer scale is 6,000 times. By applying the movement of the galvanometer to the actuation of a relay, signals can be operated for control purposes. Thus with three such units, one can be made to operate a white lamp for within tolerance, another a red lamp for outside tolerance and a third a green lamp for below tolerance. The method has been applied to the automatic control of grinding machines. Gauges for obtaining permanent records of rapidly changing stresses, such as occur in locomotive connecting rods, are quoted by Hathaway and Lee, using AC of high frequency and an oscillograph.

Two types of problem have been attacked on similar lines with the aid of external and internal "Electrolimit" gauges manufactured by Taylor, Taylor and Hobson under licence from Pratt and Whitney, (U.S.A.). External gauges capable of measuring materials up to 4 in. or 10 in. in thickness have an accuracy of 0.0025 in., while the internal type makes it possible to measure with the same accuracy the size of holes in components and compare them with master ring gauges; it will deal with spindles up to 3 in. diameter. A more recent instrument of the latter type has been developed for gauging the diameter of gun bores.

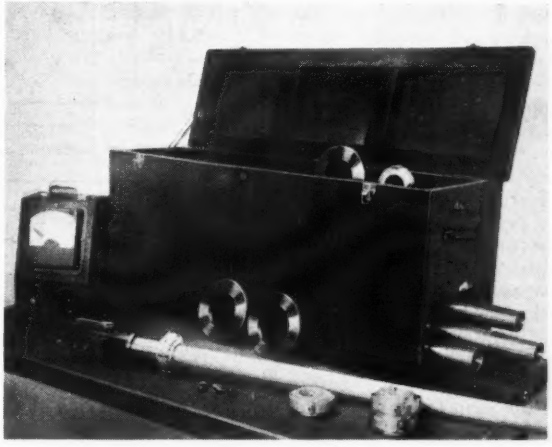
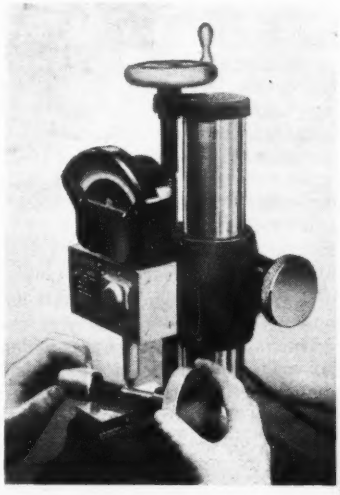


Fig. 4.—Gun-bore gauge accessories

The basic principle of both types is the combination of mechanical gauging contact and electrical magnification. The bench apparatus comprises a ribbed optically flat base, or anvil, on which is mounted a vertical pillar carrying the electric head. This head is provided with a contact spindle of hardened steel mounted in a long sleeve with a diamond gauging point. The distance between this point and the anvil is set by means of master slip gauges. The displacement of the gauging point caused by variation in size of the work controls an electric circuit which shows the errors on a calibrated microammeter mounted in the head.

The principle of the head is illustrated in fig. 1, showing that the movement of the vertical pillar S, the actual "measuring rod," actuates the spring-mounted armature A, which moves between the two inductance coils T_1 and T_2. These coils form two arms of an AC bridge circuit which is put out of balance by the slightest movement of the spindle S. Zero adjustment is provided for, by which the desired magnification can be set, using the master gauge. The dimensions of the 4-in. gauge are 17½ in. overall in height, approximate bench space 9 in. by 10 in.,



Figs. 2 & 3.—"Electrolimit" gauges for external dimensions (above) and internal comparison of holes (right)

and approximate net weight 56 lb. The size of the anvil is 1½ in. by 3⅜ in. It is seen in operation in fig. 2 and fig. 3 shows the internal gauge in use; the gauging spindle is mounted horizontally, and is provided with two contacts of tungsten carbide strip let into the spindle and a diamond gauging point which actuates the armature. The special gun bore gauge is shown in fig. 4.

One of the outstanding uses of the electric thickness gauge is associated with the manufacture of steel strip, since variations from a preset value of 1/10,000 in. are important. In one gauge of Cambridge make for this purpose the strip passes between two hardened steel rollers, the lower of which is fixed rigidly to the base. The upper roller is carried on an arm pivoted on a crossed frictionless bearing. The upper roller thus follows any increase or decrease in thickness of the strip, and its displacement directly actuates an armature placed between the poles of two fixed opposed electro-magnets, AC from equal windings of a transformer being passed through the two magnet windings. A full-wave Westinghouse rectifier is included in the circuit of each magnet (fig. 5). The two rectifiers are so interconnected that any difference in the currents passing through the two magnets is indicated on the microammeter. Divergence from the set thickness of the strip to an amount of 0.002 in. on either side of a central zero point is indicated.

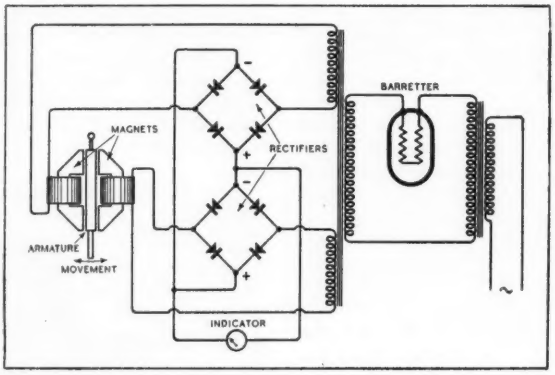


Fig. 5.—" Cambridge " thickness gauge for steel strip rolling mills

When a permanent record is required use can be made of a motor-driven instrument which is designed to record variations in thickness at the centre and two outer edges of the strip. Three gauges, each with its own galvanometer, are used; the pointer of each meter is depressed once in every five seconds, making a more or less continuous line of closely spaced dots on a travelling paper band.

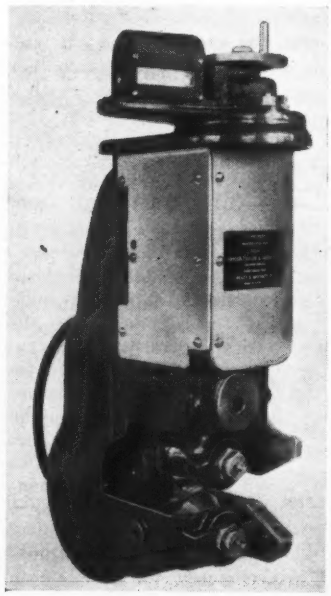


Fig. 6.—" Flying mike " continuous steel strip gauge

The " Electrolimit " gauge has been adopted on a large scale in cold rolling steel mills of all types, reversing, tandem and temper pass. A slide or rail mounted on the mill carries the gauging unit in such a manner that the gauge follows the strip and floats with the pass line. Spring loaded rollers between which the strip passes are carried in a mechanical arrangement which embraces a pair of inductances between which the gauge armature moves. These coils are fed from a differential transformer, which is housed in a power unit along with the other two inductances of the bridge and a mains voltage regulating system, also a rectifier for the DC indicating microammeter. The continuous " Electrolimit " gauge (fig. 6) is claimed to give continuous strip thickness recording to ten-thousandths of an inch with rolling speeds of 1,500 ft. per minute, and is known popularly as the " flying mike ". The gauge circuit can be made to switch on lamps or sound horns if thickness limits are exceeded. It is set for any desired thickness by turning the hand-wheel seen on top.

A highly interesting development is the " classifier " gauge. The gauging itself is done on the mill while the material is still in strip form, but it controls the sorting of the cut sheets after the strip has been cut in the required lengths by flying shears. The time delay between the sorting mechanism and the gauging is synchronised by means of a special tachometer generator; by this ingenious combination off-gauge sheets are positively separated from those that are passed.

While not strictly speaking a gauge for measuring actual thickness, the Pratt and Whitney strain gauge operates on similar lines. After a roll change or shut-down has been made on a mill, the pressure exerted by the screw-down when re-starting will cause the mill housing to stretch in a relation which has been found to be directly proportional to the pressure. This stretch, converted by electrical bridge measurement as above described, can be thus made to record the pressure directly in pounds on indicating or recording instruments which may be located at any desired point.

Fig. 7.—" Salford " layer-depth meter for thick or thin coatings

Another instrument which is particularly useful for indicating, in this case continuously, the thickness of metal foil, or strip, or sheet coming from a rolling mill is a Salford (G.E.C.) micrometer which employs a high-frequency AC thermionic valve generator to energise two gauging coils. The transfer of energy from one coil to the other depends upon the cross-sectional dimension and electrical conductivity of the foil. Thus, after rectification of the high-frequency current, it can be made to indicate thickness on a DC instrument.

The Salford layer-thickness meters of the Tait-Chalmers pattern include models for gauging the depth of coating of non-magnetic substances on magnetic bases. There are two types: one for general application measures the depth of tin or sprayed metal, or paint, enamel, etc., on sheet iron for example; while a more sensitive type is capable of determining very thin layers, such as nickel plating on brass, and of measuring samples of foil or paper. These instruments are simple to use and are direct reading. They operate from AC mains at 230V, the procedure being to place an exploring coil head (fig. 7) on the surface to be

examined, which can be done with equal facility on such irregularly shaped objects as tanks and drums as on flat or corrugated sheets. The tinplate layer meter has a range of 0.002 in.

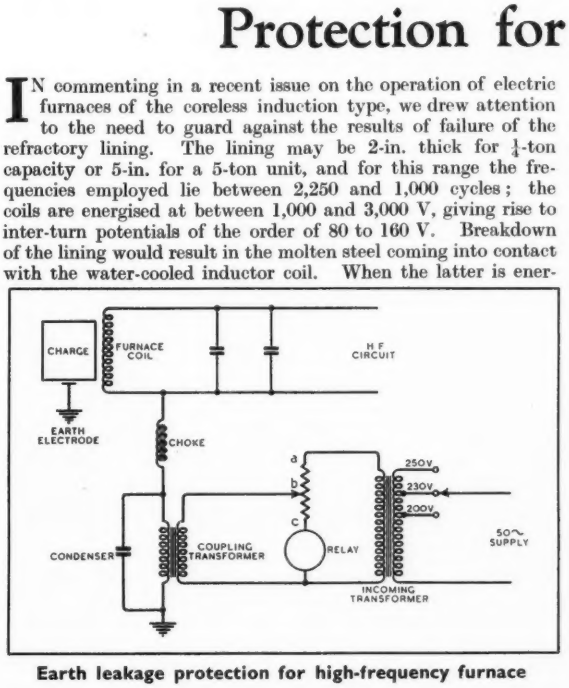
A magnetic method of measuring the thickness, virtually at a point, of zinc and tin coating was originated by Mr. C. E. Richards (Post Office Research Station) and developed by the International Tin Research and Development Council. A suitably balanced lever has a ball-ended cobalt-chromium steel permanent bar magnet fixed at one end. In the operative position the ball end of the magnet rests on the surface of the sample of tinplate being examined. The force needed to detach the magnet depends on the thickness of the non-magnetic coating and is determined by means of a siphon-actuated balance. By clamping the specimen to a mechanical stage, measurements can be made at a series of points and contours plotted.

The thickness of non-magnetic metals can be measured from one side only, by a Cambridge-made instrument developed for I.C.I. (Fertiliser and Synthetic Products), Ltd. By means of an electro-magnet, comprising a soft iron bar with a central magnetising coil, an alternating field of constant mean value is applied at right angles to the wall of the specimen. Thus eddy currents are set up in the metal which are proportional to the AC conductance of the material, and therefore they constitute a measure of its thickness. The eddy currents are determined by a search coil mounted on the end of the electro-magnet bar, induced currents from the magnetising coil being compensated for by a third coil fixed at the other end of the bar. The search coil is connected to a micro-ammeter which, for any given material, can be calibrated to indicate thickness.

A method of measuring the thickness of a plate or slab of conducting material from one side only, due to Dr. W. M. Thornton, is by ascertaining the voltage drop between two centre-punch marks made on the surface, slightly within two outer marks, DC being passed between the outer ones and adjusted until the voltage has attained a certain value. The inner punch holes are connected with a meter and the value of the current increases with the thickness of the plate, rapidly at first and then more slowly. The instrument is first calibrated on a test piece of approximately the same material as the plate under test, as the method obviously depends on the specific resistance. It does, however, provide a means of measuring the thickness of plates of ferrous metals, such as boiler shells, etc., when oxidised. Some refinement of this method has been suggested by A. G. Warren (*Journal, I.E.E.*, May, 1939).

Protection for H.F. Furnaces

IN commenting in a recent issue on the operation of electric furnaces of the coreless induction type, we drew attention to the need to guard against the results of failure of the refractory lining. The lining may be 2-in. thick for ¼-ton capacity or 5-in. for a 5-ton unit, and for this range the frequencies employed lie between 2,250 and 1,000 cycles; the coils are energised at between 1,000 and 3,000 V, giving rise to inter-turn potentials of the order of 80 to 160 V. Breakdown of the lining would result in the molten steel coming into contact with the water-cooled inductor coil. When the latter is energised an arc is struck which burns through the copper, ultimately puncturing the water circuit.

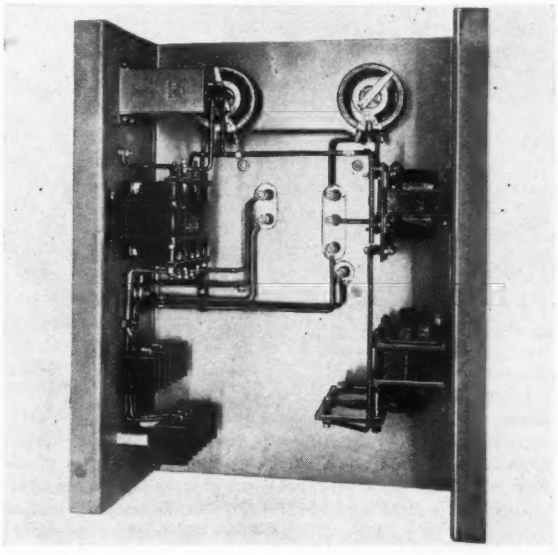


Earth leakage protection for high-frequency furnace

Means are required to make the HF circuit dead as soon as, or preferably before, contact is made between the furnace coil and the charge. A method developed by the Metropolitan-Vickers Electrical Co., Ltd., which has proved successful in practice is based on the functioning of a relay connected between the HF circuit and earth. The circuit is completed by contact between the coil and the charge, the latter being earthed through an electrode buried in the bottom of the lining which when hot becomes a conductor.

The accompanying diagram shows the circuit employed. This operates through the injection into the HF system of a 50-cycle current of a magnitude that depends upon the resistance between the HF system and earth. Should the 50-cycle current exceed a certain value, a relay trips the main HF contactor. A small single-phase transformer with primary tappings supplies a relay through a tapped resistance, forming a circuit with a high-impedance step-up coupling transformer across the secondary of which is connected a by-pass condenser. One end of this secondary is earthed and the other goes to the HF circuit *via* a HF choke. Two sets of contacts are fitted to the relay, one connected with the tripping circuit of the generator contactor, the other with a lamp that indicates when the relay has operated. As the coupling transformer current increases, the potential drop along resistance *a-b* increases until the relay becomes de-energised, which happens when the current flowing through it with a fault resistance of, say, 3,500 ohms falls from its maximum of 55 mA to 32 mA; with a fault of zero ohms the relay current will be 10 or 12 mA. The relay will also trip if the 50-cycle supply fails.

The value of condenser is selected to ensure that sufficient HF current is not injected to keep the relay energised. The most usual fault is that of the lining becoming spongy, allowing metal to trickle slowly through towards the coil in capillary formation, but this may allow several melts to be carried out before trouble occurs. The relay is reported to have operated in such circumstances before the metal reached the induction coil, so that no arc was struck and the coil was undamaged.



Back of equipment panel

ZINC PLATING

Means Adopted for Securing a High Lustre

By C. C. Downie

THE modern tendency with many electro-plating processes appears to be to get as high a lustre as possible, whereas formerly the chief consideration was to ensure prevention of rust. Most of the earlier processes were devoted to coating surfaces which without the plating would be seriously corroded, but to-day plating is performed not only upon easily oxidised metals but also upon corrosion-resisting alloys with a view to improving their general appearance. Where a strongly resistant surface is in demand for all-weather conditions, cadmium has largely come to the fore, and a dull plating suffices for most aircraft sections.

In other fields, the trend is towards increased lustre, as witness the wide expansion of chromium plating in its modern coloured varieties, which can be obtained in all classes of tints and shades. This production of a bright mirror-like surface usually adds considerably to the costs, not only with chromium, but also with cobalt, nickel and other similar metals.

Should it be possible to acquire the same bright lustre without the need for such expensive metals, all kinds of work would be dealt with in this manner. Among the most recent developments within the past three years is the introduction of zinc plating which gives a genuinely bright lustre and indicates that the much desired cheap metal plating will be successful. Ordinary zinc plating is carried out in a bath composed of 3 lb. zinc sulphate, 3 oz. sodium chloride, and 4 oz. aluminium sulphate per gal., at a temperature of not less than 70 deg. F., while current is applied at from 8 to 14 A per sq. ft. Part of the aluminium sulphate is sometimes replaced by ammonium chloride, *i.e.*, 2 oz. of each per gal. in place of the 4 oz. of aluminium sulphate, and ¼ oz. of sulphuric acid is included. The aluminium sulphate should be dissolved separately in water, and then added to the plating bath. Where the deposit showed a tendency to roughness, grape sugar was at one time greatly believed in as a panacea, but is to-day abandoned, as also is boric acid which was added to the extent of 2 oz. per gal.

Advantages over Galvanising

Ordinary zinc plating has to compete with galvanising and sherardising (heating with zinc dust which sinters on the surface of the underlying iron), both of which are economical processes. The only claim which could be made to support ordinary electro-plating was that the coating was of even and easily controlled thickness and was more stable mechanically than that produced by hot galvanising. The fact that electro-deposited metal is of the highest purity, and hence offers better resistance to corrosion has not been emphasised. It was admitted as far back as 50 years ago that galvanising was more detrimental to the quality of the iron treated than electro-plating, which exerted practically no ill effects.

As with all bright plating operations, the brightness of the plated zinc depends to some extent on the lustre of the surface being plated. For example, a reliable grade of cold-rolled steel will give a better finish after being plated than pickled hot-rolled stock. Where freshly sand-blasted or rolled castings require only a weak acid dip, the plating is usually satisfactorily bright, but a prolongation of the dipping or use of a stronger acid dip renders the surface unsuitable. Thus where there is a sufficiency of rust or oxide scale to necessitate such pickling, bright zinc plating cannot be successfully performed, since areas would exist where the zinc would not be properly deposited. In a similar manner, the introduction of such impurities to the bath would also offset the bright lustre.

With ordinary zinc plating, the danger of zinc sponge formation is prevented by the use of the boric acid mentioned, which is maintained by the regulated addition of sulphuric acid. By using increased current density, hydrogen ion discharge tends to be prevented. Current density is varied with the electrolyte composition and the room temperature. Where the latter is unduly low, a high-current density is necessary, otherwise considerable hydrogen evolution can occur. When alkaline cyanide solutions of zinc were first introduced it was soon realised that more uniform coatings could be obtained, and although principally used for producing thin deposits, the coating was found to be more impervious than those from sulphate baths, and superior throwing power was obtained.

The solution is represented by a complex zinc cyanide formed by a composition of 3 oz. zinc cyanide, 3 oz. sodium cyanide, 4 oz. sodium hydrate, and ¼ oz. aluminium sulphate per gal., or, alternatively, 4 oz. zinc cyanide, 4 oz. sodium cyanide, 4 oz. sodium hydrate, and 2 oz. ammonium chloride per gal.

Improved Solution

While many individual platers of repute can provide a reliable and genuinely bright zinc plating, it is only within the past three years that a solution has become available whereby any plater can make a success of this work. A more concentrated zinc cyanide solution is used, which includes what is termed a " brightener." A recommended composition consists of 12 oz. zinc cyanide, 4 oz. sodium cyanide, 8 oz. sodium hydroxide, and ½ oz. Mazic brightener No. 3 per gal. When all salts have been dissolved the zinc in solution is represented by between 6 and 7 oz. per gal., and the ratio of metal content to total sodium cyanide should be maintained in the proportion of 1 to 2½.

The total sodium cyanide amounts to 14 oz. per gal., but at concentrations below the above ratio the brightness of the deposit diminishes. The prepared brightener is dissolved in hot water and then added to the bath, and it is claimed that only 2 oz. are consumed per 100 gal. per eight-hour day. As sodium carbonate formation is facilitated at high temperatures, the electrolyte should not be allowed to exceed 100 deg. F., and the best temperature for barrel plating should not exceed 85 deg. F. As the work proceeds, the temperature tends to rise because of the large amount of current passing through the solution, and for continuous operation it is advisable to cool the bath. Both cooling and circulation add to the costs of the process, while the zinc anodes used must be of the best metal so as to ensure freedom from sludge and give a perfectly clear solution and freedom from any suggestion of roughness in the deposits.

By the foregoing process, 23.3 Ah is required to deposit 1 oz. of zinc, and 13.7 Ah to deposit 0.001 in. With barrel plating, at least 200 A should be drawn per barrel at from 10 to 12 V. Ball anodes of zinc are used in spiral wire containers with the barrel plating. The thickness of plating depends on various factors such as the shape, size and load of the articles, the efficiency of the solution, the anode area, the time allowed for deposition, the temperature and the voltage and current available. The dropping test of Hull and Strausser is used, when the current has been applied at its maximum, to ascertain the thickness of deposit for various periods.

When plating has been completed, the articles are removed

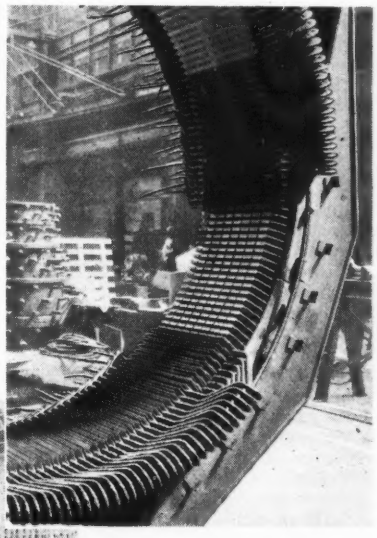
from the solution, rinsed in cold water, rapidly dried in a centrifugal, when they will be found to display a bright lustre not generally associated with zinc plating. Very small and light articles are subsequently tumbled in sawdust selected from heated hardwood.

An idea of the kind of work for which the foregoing process is suited can be obtained from a survey of the vast selection of goods, for which the dull finish of ordinary zinc plating will be enough to prevent corrosion, but which for appearance are provided with an extra plating of more expensive metal. It is here that bright zinc plating is intended to compete.

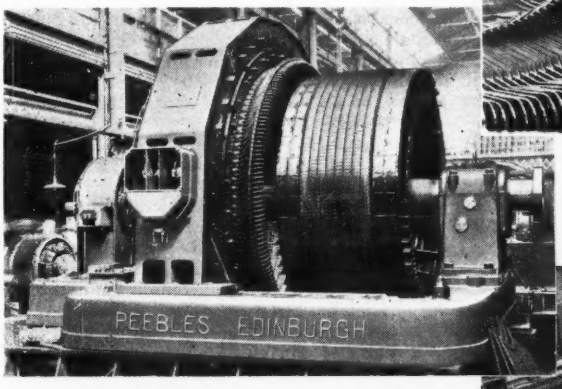
Large All-Welded Motor

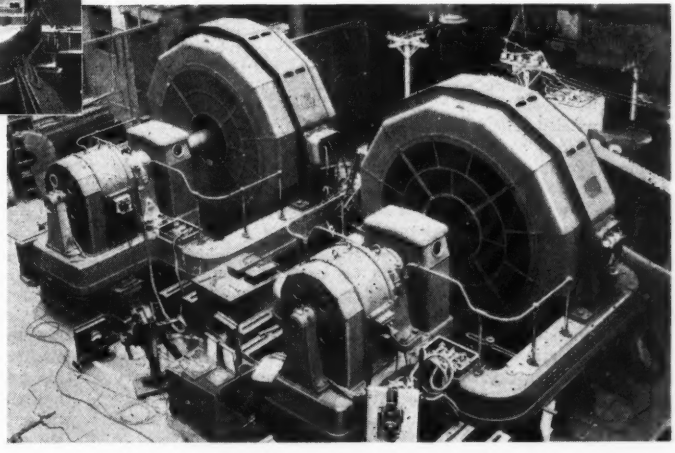
BY fabricating a 1,900-HP, 250-RPM, three-phase motor from steel plates with the aid of oxy-coal gas cutting and electric arc welding, Bruce Peebles & Co., Ltd., report important savings in production costs, economy in materials and reduction in manufacturing time when compared with castings, together with increased strength and rigidity. This machine is of the synchronous-induction type and is one of a large number, for which repeat orders have been received, which have been built for driving air compressors. It is 16 ft. long by 14 ft. high and weighs 40 tons. It has been designed to operate at unity power factor on a 50-cycle, 11-kV, circuit and is similar in construction to a slip-ring induction motor except for a larger air gap to ensure synchronous stability and more rotor copper to reduce losses.

Self-ventilation is provided by paddle-type fans and air deflectors on the rotor, the heated air being expelled through openings in the stator frame. An air duct is provided between the direct-coupled exciter and the slip-rings. Air trunks to the exciter and slip-rings complete the circuit, so that the fan fitted to the exciter armature serves the dual purpose of drawing in air and propelling it along the air duct and through the rotor slip-rings and brushgear. All connections between the exciter and the rotor are led through the air duct, the only external connections being those for the starter and field rheostat. The stator frame consists of two end pieces and a centre rib of heavy-section steel frame held together on an inner periphery by steel tie-bars and on the outer periphery by a stout steel plate forming the outer surface of the frame. The feet are formed from a steel bar and the whole construction is built to jigs and gauges with a view to accurate alignment and correct height of centres.



Partially-wound stator frame





Above : Stator racked clear of rotor
Right : Two motors undergoing works tests

At the end of the insulated high-alloy steel core are teeth rigidly supported by heavy-section mild-steel fingers, which extend over the whole depth of the core and well back on the frame end plates. These fingers transmit the pressure exerted by the clamps to the extreme edge of the teeth tips, thus maintaining uniform pressure throughout the core.

The windings consist of former-wound coils laid in open slots and mechanically protected by leatheroid troughs; they are retained by hornbeam wedges driven into grooves in the teeth tips, and the method of construction adopted excludes air spaces and provides coils of great rigidity. Mica, directly applied and baked on by means of hot-wrapping machines, forms the main insulation. The coils are sealed with insulating enamel and rendered waterproof by impregnation. Displacement of the end windings due to heavy surge conditions is prevented by rigid bracing from the frame by an insulated steel ring. The coils have withstood a pressure test of 11 kV between turns and 66 kV to earth. Provision is made for shifting the stator sideways.

The hub of the rotor is of cast steel, the spider being fabricated in two rings of steel plate stiffened by cross stays at the outer periphery and by large steel plates near the centre which also act as air deflectors. Dovetail keys for securing core laminations are welded into prepared slots round the outer periphery, a jig being used to ensure accurate location. Massive fitted bolts hold the spider to the hub. The core is built up in the same way as the stator core. The rotor is bar-wound and the slot insulation is mica moulded direct on to the conductors.

By means of a liquid starter in the rotor circuit the machine is started up as a slip-ring induction motor and as the speed increases the exciter, which is permanently connected in the rotor circuit and is self-exciting, builds up its field. Slip in an induction motor is small and on reaching full speed the rotor pulls into synchronism automatically. The machine then operates as a synchronous motor and the power factor is adjusted.

Flexibility as regards speed control was the deciding factor in the choice of a synchronous-induction motor instead of one of the salient-pole synchronous type. During some periods the machine has to operate at from 250 to 50 RPM at a high p.f.; below synchronous speeds it acts as a plain induction motor.

INSTITUTION PROCEEDINGS

Andrew Laing Lecture. Factory Distribution. Welded Construction.

The Industry's War Effort

AN attempt to direct attention to the electrical industry's part in the national struggle, with suggested means of adding further contributions to the national needs, was the aim of Mr. W. A. A. Burgess (A. Reyrolle & Co., Ltd.) in the inaugural address which he delivered on October 21st as chairman of the North-Eastern Centre of the INSTITUTION OF ELECTRICAL ENGINEERS.

Mr. Burgess said that the electrical industry had been so well equipped with precision tools, skilled personnel and resourceful management that very many of its factories had been able to turn over at once to the production of munitions of war and in spite of direct war activity to satisfy the needs of the electricity supply industry, which had continued to expand. But further very important help, Mr. Burgess contended, could be given to industry and to the national effort by all users of electrical equipment if they would utilise standard products wherever possible.

Even to-day, in the midst of hostilities, his experience was that a large number of special developments were called for by engineers who desired new and often revolutionary designs or modifications of standard equipment not justified either by engineering or by economic requirements. Avoidable special development work should not be imposed upon staffs urgently required for output. A case in point might be made in respect of precision metering, which at the higher voltages and smaller loads involved multi-turn current transformers and often special magnetic stampings, the production of which was occupying the time of men and machines, and was using not inconsiderable quantities of the rarer metals so urgently required in other directions.

It was his experience, too, that manufacturers often developed special fittings, such as cable boxes, or enclosures for minor apparatus, or a mounting or housing for some of their own minor products, when a look through another manufacturer's catalogue would provide them with a standard component that could be made to do everything required. The avoidance of such special and unremunerative work was as much a war effort as something much more spectacular.

Rationing Home Consumption

No manufacturer had the right, either commercially or nationally, to ignore the demand for his staple products. But Mr. Burgess contended that electrical manufacturers, individually or collectively as might suit them best, should put their capabilities before the Minister of Supply and insist that he should ration the production of normal manufactures for home consumption to the irreducible minimum and, at the same time, should assist them to maintain a 100-per-cent. load-factor with such war products as he most desired and the factories concerned were best capable of.

Not only manufacturers, but electricity producers also, should individually ration themselves severely to strict national requirements as the smoothest and most efficient means of reducing the demand for men and materials. The industry should lead the Commissioners in this respect, and the essential war demands upon the electricity supply industry, which were and would be numerous and heavy, should be planned to provide for necessary peacetime expansion and interconnections. If the supply industry was really to ration itself on a conscientious national basis, the Electricity Commissioners must be prepared to relieve it, at least temporarily, of galling restrictions relative to voltage variation and continuity of non-essential services. An Order in Council just published, relating to the removal of obligation to supply, should be read broadly in this connection.

Some manufacturers had always prided themselves on immediate service to meet breakdowns and emergency conditions. A serious attempt was now being made by some electrical manufacturers to provide immediate replacements; by means of considerable stocks, backed by a 24-hour voluntary service of experienced men, they had already done good service. There was room for an expansion of this service throughout the country to match the efforts of the supply organisations, which appeared to be particularly efficient.

Manufacturers on the whole appeared to have made very good provision for the protection, rescue, and general welfare of their workpeople, and the supply authorities were similarly well equipped; but there appeared to be a gap in relation to contractors' men, who were required to work under hazardous conditions on repairs and on new installations at sites where there was often insufficient protection.

Industrial Processes

The electrical fabrication of metal parts by welding had received such stimulation as would certainly be reflected in an advance in construction of all kinds when peace was restored, and was providing a means of accelerating war supplies hardly dreamed of by its most assiduous advocates in earlier days. Mobile generators, for which the demand appeared to be fast abating in normal peacetime, had met a war demand in connection with searchlights, welding, and emergency lighting and power supplies that would, if nothing else, leave the country more electrically minded than years of propaganda in peacetime could have done.

The electrical deposition of metals had been given a fillip out of all proportion to the general developments of peacetime, and one might confidently expect advances in this line not only in the wet electrolytic processes but in the electrolysis of fused salts and in electrostatic deposition on paper, fabric, ceramics and glass.

The Institution as a body, in common with other institutions, had already offered the Government all assistance within its power, but Mr. Burgess said he felt personally that it might be a somewhat barren offer, and that more definite indication of capability to assist the Services should be given. Committees might be set up for the purpose of formulating means of assistance.

In particular he urged that every member of the Institution, whatever his grade, had a duty to promote overseas sales in any country where he might be or have influence. If electrical manufacturers were to give of their best in war production, and the supply authorities and general users were to ration themselves, it could only be by the help of an enhanced export trade to keep together their essential organisations and manufacturing facilities. It was true that rationing by the home user would store up a demand for the early years after the war, but that demand must be met and stimulated out of experiences of the war period. Testing and proving the products would have to go on to keep Great Britain in the forefront of nations.

Energy Transmission

FOUNDATIONS of the electrical and mechanical transmission of energy were the subject of the ninth Andrew Laing Memorial Lecture which was delivered by Dr. W. M. Thornton before the NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS at Newcastle-upon-Tyne on November 1st.

Energy was defined in its two forms, potential and kinetic, transformation from one state to the other causing the transmission of energy. It was to the means by which, in general, this was done that Dr. Thornton directed attention, remarking that though engineering operations could well be carried on without a deep knowledge of the physical foundations on which they depended it was well to know that such foundations existed and, further, that one law governed the whole range of the transmission of energy, whether in electrical or mechanical engineering. This law was little known and rarely referred to. Though occasionally used in the solution of electrical problems it had never hitherto been applied to the consideration of those which dealt with the transfer of energy by mechanical means.

The nature of gravitational potential energy was unknown and problems of the transfer of energy were met with daily to which as yet there was no complete answer. How, for instance, did a pendulum work? At the end of its swing the energy was all potential, in the middle it was all kinetic. There was an

almost perfect conservation of energy, but no one knew how the transformation took place from the one form to the other.

One property of gravitational space that engineers might accept without question was that to hold the planets in their orbits it must be able to support great tensile forces. How they were derived physically from the matter of the sun and the earth was unknown, though since matter was electrical in its constitution a gravitational field must have an electrical component in order to take hold of it. For many purposes the conception and use of this component was sufficient to illustrate the universal law to which the lecturer referred; on the assumption that all mechanical forces were electrical in their origin it might even be used to explain the working of a pendulum.

How the transmission of energy could take place through an insulating medium was shown some seventy years ago by James Clerk Maxwell, who based his electro-magnetic theory of light on Faraday's discovery of magneto-electric induction and on the polarisation, or strain, of insulating materials in an electric field of force. Though he had found by mathematical analysis the velocity with which electro-magnetic waves travelled in space, and knew that both the electric and magnetic fields in these waves were transverse oscillations of the ether at right angles to one another, he did not find the law connecting them and the mode of transmission of their energy. This was done some twenty years later by Prof. J. H. Poynting, who derived the simple and powerful relation that everywhere in nature energy flowed by the mutual reaction of electric and magnetic fields, that it was delivered in a direction at right angles to the plane containing both of them, and that the power was simply proportional to the product of the fields. This law controlled the passage of every form of electrical or mechanical energy and was one of the most illuminating physical relations in nature, since electricity or electrification moved everywhere according to this rule.

Fields of Force

There were no known means of causing tensions or compressions in free space except by electrical or magnetic action. Twisting a cord put it both in tension and lateral compression, which suggested that such fields might be essentially states of rotational stress in the ether caused by the presence of charges that had themselves a rotational structure. That electrons and protons had their own magnetic fields, always rotational or circuital, implied that there was in them an intrinsic rotation, possibly of vortex tubes of the ether, which still awaited full solution. On the forces between protons and electrons, when gathered together into their closest union, the whole fabric of the material universe depended.

Around and in an electric wire carrying a current there were two electric fields, one outwards or inwards at right angles to its surface through the insulation around the wire, and the other along the conductor, commonly known as the resistance drop. These fields served two entirely different purposes. By means of the former, energy passed along outside the wire to be absorbed in the load at the end; the latter directed energy into the wire to supply the heating effect of the current in it.

The concentration of power was not in the wire, but in the insulation; no power was transmitted *through* the wire. Any electro-magnetic energy that entered a metal never came out of it except as heat, or in the case of machines as mechanical stress. In a single-core cable the whole of the energy transmitted travelled as a cylindrical stream in the insulation between the inner and outer conductors. There were no exceptions to this law of transmission by insulation.

The sole use of the wire was to carry a current in order to provide a sustained magnetic field by which the stream of energy could be maintained through the electric field in the insulation. The heating of a lamp filament or any conductor that was caused by the flow of the current in it was a combination of effects. A current consisted of a vast number of electrons streaming through the wire, forced along by the circuit voltage. They collided with the molecules in the crystal framework of the metal, and since this framework was not quite rigid it gave way a little at every collision. In doing so it took energy from the electrons and slowed them down, but the energy of molecular vibration increased because of the impacts and the wire became hot. To maintain the current there must be, because of this absorption of energy, an electric gradient along the wire. There was, while the current flowed, a magnetic field around the circumference, and the direction of the flux of power caused by these two fields was at right angles with the surface. All the energy appearing as heat in the wire, as in a lamp filament or radiator element, entered through the surface of the wires *sideways* in this manner. Because of the drop of voltage due to the resistance of the wire, the positive end was at a higher potential than the other, so that there was a field in the space around the wire parallel to the voltage drop in it, which had a maximum value at one end of the resistor and was zero at the other. It was by the relaxation of the potential of this external field that energy entered the conductor from it to supply the heating loss.

From the electrical theory of the constitution of matter, propounded by Rutherford, the lecturer passed to examples of the application of Poynting's Law (later independently stated by Heaviside). For energy to travel there must be in every case an electrical field E and a magnetic field H at right angles to it. In electrical transmission these fields were between and around visible conductors; in mechanical transmission they were between invisible molecules, though the shapes of the molecular fields, as shown by Sir William Bragg in his Laing Lecture two years ago, could be observed and recorded by X-ray and cathode-ray analysis. The power P, sometimes called the Poynting flux, was at right angles to the plane containing E and H and was equal, numerically, through unit area to the product $EH/4\pi$. In high-voltage systems the electrical field was much the greater of the two, in low-voltage transmission the magnetic field might be the greater.

Tobacco Factory Practice

ELECTRICAL principles and layout, followed by accounts of recent developments and modernisation of plant, in tobacco factories (with which he has been closely associated for the last twelve years) were described in the inaugural address of Capt. B. C. Bayley (chief electrical engineer, John Player & Sons, Nottingham branch of the Imperial Tobacco Co., Ltd.) as chairman of the East Midland Sub-Centre of the INSTITUTION OF ELECTRICAL ENGINEERS at Loughborough on October 12th.

Tobacco manufacture, he said, was typical of many light industries in the East Midlands, the load comprising large numbers of motors, conveyors, fans, heaters, and other plant, with a good load factor. Electricity was purchased at 11 kV in bulk with a private station generating at 6.6 kV as stand-by. Assurance of continuity was considered necessary for the group of large factories with which he was concerned (having over 9,000 employees) because a shut-down of short duration would mean a loss of output of many millions of cigarettes.

The Diesel-alternator sets, two of 410 kW and two of 630 kW, were run on load at regular intervals. Based on twenty-six runs per annum, each of 12 hours' duration, generating an average of 12,000 kWh per run, the total engine working cost was 0.938d., consuming 0.772 lb. of fuel oil per kWh produced, the rated BHP-hours run per gallon of lubricating oil being 1,580. Interlocked high-voltage circuit-breakers prevented operation in parallel with the public supply, but the busbars could be sectionalised so that part of the load could be fed from either source.

Planned Distribution

A planned distribution scheme would in the long run be safer and more reliable, though usually practicable only in larger factories. From the main 11/6.6 kV substation distribution was at 6.6 kV to six factory substations as near as possible to the centres of load, which transformed down to 420 V. Transformer and switchgear were both duplicated and isolated from each other. Experiments with "Pyrotenax" cable indicated that though very difficult to install in the larger sections, requiring high-class labour, experience might show it to be preferable to bare copper connectors or heavy low-voltage cables, in spite of its greater cost, for example, between transformers and their control cubicles and distribution switchgear.

The factory buildings were of five and seven floors, each served by low-voltage multicore cables in vertical shafts extending to the full height of the buildings. Those trunks were connected to ironclad h.r.c. cartridge fuseboards from which circuits branched to rewirable fuse distribution boards. In some of the factories 420/105-V transformers permitted the use of ordinary fusible cut-outs for the lighting circuits; more recent 230-V installations needed h.r.c. fuse protection. The general guiding principle was that each important service should have an alternative feed, which might appear to be extravagant.

but could be accomplished with ring mains for very little extra expenditure on copper. All substations were so arranged to ensure continuity and facilitate proper maintenance of plant.

One new factory had a wholly conditioned atmosphere, 133,000 cu. ft. of air per minute being washed, humidified or dried, steam heated or cooled by the newer method of vacuum refrigeration without recourse to chemical reaction, and then evenly distributed through ducting. Double windows, permanently locked, prevented excessive loss, and the control of temperature and humidity was automatic. There were not many installations of that size in this country; the motors utilised, including stand-by machines, totalled 1,000 BHP, the six AC commutator motors for the main fans being of 42 and 60 BHP at 1,000/500 RPM. This and smaller air-conditioning plant represented 40 per cent. of the total load and in warm weather was responsible for 51 per cent. of the factory's maximum demand. This essential service was served by an independent ring main and separate 6,600/420-V step-down transformers in duplicate.

Short-Circuit Study

Electrically-driven processing machines, some fifty lifts, heating, lighting and the air-conditioning plant represented a load of 5,000 kW, but this was spread over several buildings taking between 350 and 2,000 kW each at 400/440 V through step-down transformers of aggregate capacities ranging between the figures mentioned.

Now transformers of 500/1,500-kVA capacity were capable of low-voltage short-circuit outputs of 10,000 to 30,000 kVA, assuming 4 per cent. reactance and a short-circuit level of 150 mVA on the high-voltage input side. Here was a fresh problem, for while 10/15-MVA tested switchgear at 400/440 V was obtainable, gear of larger rating was costly and dangerous conditions might come about if short circuits in excess of 25,000/40,000 A (RMS) could occur. Mr. Bayley therefore directed attention to the Home Office regulation (Report of Electrical Accidents, 1937) that the total aggregate of transformers installed and connected in parallel must not exceed 1,500 kVA (Cinematograph Act).

Based on the contention that a maximum short circuit of 25 mVA was the safe and economic limit, and that greater reliability of supply would be secured by lowering that limit, the author's low-voltage system had deliberately been so designed that the maximum fault energy could never exceed 15,000 kVA. It was accomplished by restricting the maximum size of individual transformers to 1,000 kVA; when 1,500 kVA and in one case 2,000 kVA became necessary such larger capacity was made up by connection in series with cast-in-concrete reactors on the high-voltage side. Mr. Bayley considered this precaution to be a very valuable measure of safety, as he could not regard lightly the possibility of a peak flow of 100,000 A (39,000 RMS) under fault conditions with its accompanying mechanical and thermal effects. A further degree of safety was obtainable now that tested air-break switchgear of 15/25-mVA rating was available, as it reduced the fire hazard, however small it might be, associated with oil-immersed gear.

All the factory cables, which were often left out of these considerations, were capable of withstanding the currents likely to flow under the short-circuit conditions outlined. Some sixty 6.6-kV switching equipments rated at 150 mVA were safeguarded by the series reactance of the step-down transformers, irrespective of developments on the high-voltage input side; otherwise the short-circuit capacity might be increased to 350 mVA, forcing considerable protective expenditure upon the user to remedy circumstances he could not control.

Auxiliary Gear

The factories covered 23 acres with the equivalent of 40 acres of manufacturing and storage space, and were served by sixty-eight 420-V switching equipments from twelve step-down transformers through 2.5 miles of 6.6-kV cable and sixty 6.6-kV switches. Their size necessitated automatic indication (with the aid of a semaphore keylamp mimic diagram in the main substation) of the positions of all high-voltage circuit-breakers, together with visible and audible warning of switch trippings and an independent telephone system for issuing operational instructions, the control cables being of the multicore telephone type, energised by batteries with associated charging equipment.

Considerable attention was given to fire and explosion hazards when designing the substations. Sectionalised automatic and semi-automatic water emulsifying plant and portable carbon dioxide gas extinguishers were provided in the high-voltage switchgear and transformer cubicles; means of oil drainage differed according to site conditions. Fire alarms were of three kinds, operated by thermostatic switches, by pressure-gauge contacts actuated by the compressed air in the water projecting pipes, and by water-flow diaphragm switches.

For determining maximum demand and power factor two "Printo Maxigraph" recorders (kW and kVA) could be plug-connected in turn to "Trivector" instruments in all factory substations by means of extra circuits in the multicore cables of the automatic telephone system; a synchronous clock provided for timing.

Standardised 50-kVAr static condensers at the load ends of the main low-voltage feeders in the several factories corrected the power factor and assisted voltage regulation. They were adjusted remotely by push-buttons from the oil switches in the various substations, actuating contactors in ironclad enclosures attached to the condenser tanks, which was a flexible means of dealing with peak loads. Maintaining the power factor at 0.96 reduced the kVA maximum demand by 16 per cent., which meant a saving of £2,000 per annum. Consumption had increased 5.5 times in ten years, now being 7.5 million kWh per annum; 24-hour air conditioning rendered both load and demand factors very satisfactory.

Factory Lighting

WARTIME industrial lighting was the subject of a paper by Mr. H. C. Weston that was presented to the ILLUMINATING ENGINEERING SOCIETY in London on October 22nd. The effects of the restrictions on the interior illumination of factories were first dealt with, the author remarking that planning with sufficient regard for the simulation of natural conditions was gaining importance. He considered that it would be a pity if factory lighting were allowed to become too stereotyped and if, for example, a particular solution of the glare problem, such as the cut-off fitting, should be relied on to the exclusion of other possible and more satisfactory solutions, such as low-brightness units.

Methods of lighting reserved almost exclusively for other interiors could often be used with advantage in factories and, closer co-operation between architects, factory engineers, and lighting specialists should lead to structural design which would allow wider scope for the use of different methods of artificial lighting; in many cases the nature of industrial processes need impose few restrictions on the architect's choice of interior structure. The term "industrial lighting" would have little meaning if development proceeded along these lines.

Lighting, even in factories, served other ends besides the mere revealing of work. The broad humanist outlook and the narrower functional outlook which special requirements demanded were more compatible than was sometimes realised.

Fabrication by Welding

IN his presidential address prepared for delivery at the annual general meeting of the NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIP BUILDERS, at Newcastle-on-Tyne on October 18th, Mr. W. A. Woodeson (Clarke, Chapman & Co., Ltd.) counselled preparation for the future by reviewing those aspects of their craft which were developing now. For instance, the rapid progress of welding as a cheap and satisfactory means of fabrication was outstanding; while the most promising way of curing, rather than palliating, the evil of corrosion seemed to be the development of suitable alloys.

A substantial proportion of the earth's crust was clay, and this clay contained large quantities of aluminium, in some cases up to 26 per cent. If a cheaper method of extracting this aluminium from the clay could be discovered, serious challenge would be offered to iron, which was now the basic metal of industry; however, aluminium or its alloys could never completely displace iron from use in engineering construction. One of the chief claims of the alloys of aluminium and magnesium lay in the ease with which they could be protected from corrosion. Anodising, by means of which a hard impervious protective coating of oxide was produced on the metal, had received considerable attention. The protective coating given by the oxide film was unique in its nature; it was integral with the metal, did not peel or spall and, if penetrated, differential corrosion did not take place; the coating was extremely hard and resistant to abrasion.

There was some diversity of opinion among those who built

or superintended the building of ships, and voluminous discussions had recently taken place on the important subject of ship welding. There was no doubt, however, that this system had come to stay, and it only needed more time and experience to enable the full benefit to be reaped. The spectroscope, the electron microscope, and the application of X-rays to analysis had opened new prospects of rapid development in the application of existing and new materials.

A great service was rendered by the various Institutions which had made an attempt at unification of interests by the setting up of an Engineering Joint Council after the last war. That was a move in the right direction and would bear reconsideration on a wider scale.

It was vital to certain concerns to safeguard their private interests, but much duplication of effort could be avoided by a more open attitude towards research and universal standards of measurement, etc.

The mechanistic ideology which found its full expression in some industries that lent themselves to mass production was true to a much less extent in shipbuilding and the allied heavy engineering industries. They were still dependent no less upon the skill and initiative of the operator than upon the precision of mechanisms. For this reason there were less likely to be such radical changes as in those industries where mass production had almost succeeded in eliminating the personal element.

Electrical Dock Plant

THE short address prepared by Mr. Asa Binns as president of the INSTITUTION OF MECHANICAL ENGINEERS for delivery in London on October 18th was mainly concerned with the Port of London, with which his work has been almost entirely connected for the past thirty-four years. In the course of this he stated that the largest individual piece of new work with which he had been closely engaged was the construction of the King George V dock. For carrying out that contract electric power was supplied in bulk by the West Ham Corporation at 6.6kV, which after transformation was used for driving pumps, concrete mixers, etc.

For long periods pumping averaged 10,000 gal. per minute with a maximum of 13,000 GPM. In general the concrete mixers were driven by 20-HP motors. More than thirty cranes were in use on the site, ranging from 5 to 10 tons capacity. The dock had been equipped with sixty-six electric quay cranes of 3 tons capacity for handling ships' cargo. The bridge over the entrance lock was electrically operated, of the double bascule type; its weight was 740 tons. Electrically-driven pumps were capable of emptying the dry dock in three hours; each of two pumps developed 820 HP. Apart from general purpose quay cranes and electric trucks, special plant was being increasingly employed for dealing with differing commodities in bulk.

Scottish Mining Engineers

IN opening the winter session of the West of Scotland Branch of the ASSOCIATION OF MINING ELECTRICAL ENGINEERS at Glasgow the new president, Mr. Robert Russell (Motherwell) referred in his presidential address to the importance of certification and what the Association was doing regarding examinations. He appealed for support from all engineers engaged in mines. Mr. James McCann received a prize for his paper on "The Development of the Coal Cutter." Films dealing with coal face work lent by Dr. Winstanley, of the Mines Department, were shown.

The new session of the Lothians Branch of the Association was inaugurated when Mr. G. P. Rutherford delivered his presidential address in which he urged young engineers to take full advantage of the training facilities available. He said legislation designed to increase safety in mining was drawn up in the light of previous experiences, and the margin of safety could be further improved through the mediums of education and discipline. The Association's certificate of proficiency was presented to eight members of the Branch. Mining installations were dealt with in an open discussion.

E.P.E.A. (London Group)

THE London Local Technical Group of the Electrical Power Engineers' Association has cancelled its meetings for 1940. The papers arranged to be read will either be published in the *Journal* or be available in printed form on application to the head office. A decision with regard to papers and lectures arranged for 1941 will be made at a later date.

CORRESPONDENCE

Every letter must be accompanied by the writer's name and address preferably, but not necessarily, for publication. The Editors cannot accept responsibility for correspondents' opinions.

Technical Training

I WAS pleased to read the views of "Thrice Chartered" in your issue of October 25th. Surely the present emergency will finally convince the I.E.E. that the "sound practical electrical engineer" is deserving of at least the same recognition as the theorist.

As an electrical engineer of many years' experience, both as a worker and employer, I have come into contact with a considerable number of chartered electrical engineers and cannot help feeling that they attach undue importance to the fetish of the letters which they are entitled to append to their name.

Incidentally, just what does "A.M.I.B.E." mean? During the last two years I have found this group of letters appearing on the business notepaper of a number of small concerns.

October 28th. "UNCHARTERED AND UNREPENTANT."

Factory Lighting

With reference to the article by "Lighter" in your issue of October 25th, the figures quoted for the lumen output of tungsten-filament lamps are those given in B.S.S. 161—1937. It would have been more correct, though only slightly altering the "coverage" calculations, to have quoted the values contained in the superseding edition published in June, 1940, with the added information that the figures refer to 230-V lamps.

In the 1940 edition, a note in the preface states that the only difference as regards nominal lumen output figures occurs in connection with the 150-W lamp, although a comparison between the eighth and ninth editions reveals differences for all single-coil lamps from 15 to 1,500 W.

Bath, *October 25th.* J. B. HARRIS.

Low Illumination Values

We have read with considerable interest the article on "Low Illumination Values" by Mr. G. H. Rawcliffe in your issue of October 18th, in which he describes modifications made to a lumeter to enable readings of a very low illumination to be taken. We would like to record the fact that most modern portable photometers are very easily adapted for the taking of readings down to 0.002 ft.-candle, but it is not generally recommended that commercial instruments should be used for measuring illuminations of the order of 0.0002 ft.-candle such as are being used in A.R.P. street lighting.

We note that Mr. Rawcliffe, in describing the instrument mentioned in his article, has used the Holophane company's registered trade mark "Lumeter." We must point out that this name must not be applied to any instrument other than of Holophane manufacture. From the illustration of the instrument in the article it appears to be similar to a very early form of Holophane "Lumeter" and it may be that Mr. Rawcliffe used such an instrument for his observations.

London, S.W.1, *October 28th.* HOLOPHANE LTD.
S. ENGLISH, *Technical Director.*

Comparison of Resistors

IN a research paper of the National Bureau of Standards (R.P.123 15 cents: Superintendent of Documents, U.S. Government Printing Office), F. Wenner presents information collected by the Bureau relating to "Methods, Apparatus and Procedures for the Comparison of Precision Standard Resistors." The paper includes discussions of the Wheatstone and Thomson bridge methods and of resistance comparisons of one part in a million and deals with various factors affecting the precision of such comparisons. It is pointed out that conclusions reached by Heaviside, Maxwell and others were based on assumptions that do not conform to present conditions.

A method of analysis of network containing both linear and non-linear four-terminal conductors is given, and the theoretical basis for the experimental procedure used in determining the effect of slight defects in the insulation is pointed out. This is followed by a brief discussion on Ohm's law from the standpoint of precise measurements and of units of resistance.

PERSONAL AND SOCIAL

Information regarding new appointments and other matters of interest for this page are welcomed

BY ten votes to five Edinburgh Corporation Public Utilities Committee on October 25th recommended that the sum of £1,000 should be paid to **Mr. Edwin Seddon,** who recently retired from the post of electrical engineer and manager. A sub-committee's report stated that the payment would be in respect of work which Mr. Seddon had undertaken in connection with the design of three large power station extensions and the development of the distribution system. The sum would be taken from the allowance receivable for administrative expenses from the C.E.B. The City Council has decided, however, not to approve the recommendation.

At the opening meeting of the North-Eastern Centre of the Institution of Electrical Engineers at Newcastle **Mr. W. A. A. Burgess** was installed chairman in succession to Mr. H. G. A. Stedman.

Mr. Stedman presented five members with premiums awarded by the Council of the Institution for papers read during the last session.

Mr. W. A. A. Burgess

Mr. Burgess was educated at King Edward VII School, King's Lynn, and at Armstrong College, Newcastle. He was articled to Mr. J. Pilling, M.I.E.E., then borough electrical engineer at King's Lynn, and was engaged by the Newcastle Electric Supply Co. as a junior assistant on the completion of his apprenticeship. He subsequently joined the staff of Merz and McLellan in Newcastle and later in London.

In the early part of the last war Mr. Burgess was appointed electrical engineer to the newly formed British Dyes, Ltd., and subsequently became chief electrical engineer to their successors, the British Dyestuffs Corporation, Ltd., now absorbed by the I.C.I., and had charge of all their factories. In 1924 he joined the staff of A. Reyrolle & Co., Ltd., with whom he is at present employed as contracts manager for the central area, with which since the war he has combined the duty of chief A.R.P. officer.

By his long association with supply problems and factory installations Mr. Burgess is an authority on the application of electricity to industry, and he has also personally supervised Reyrolle's contracts sections dealing with the grid, automatic substations, supervisory control and protective gear. He has contributed a handbook on high-voltage switchgear to the Pitman series "Electrical Machinery and Apparatus Manufacture," and a series of articles on the application of electricity to industry to the technical Press.

Sir John Reith, upon whom a barony was recently conferred, has chosen the title of Baron Reith of Stonehaven in the County of Kincardine.

Mr. J. V. Gil, M.I.E.E., the inventor and designer of the system of automatic control used in Kohler-Perkins automatic generating sets, is resigning his position as technical director to the Kohler Co., Ltd., and has been appointed (as from December 2nd) chief electrical engineer to F. Perkins, Ltd., makers of the Perkins Diesel engine. This change follows the closing down of normal business operations by the Kohler Co., Ltd., as a result of the enforced cessation of imports of the American-made generating plants in which that company is primarily interested. Kohler spares and some service will still be available. The production of British-made automatic generating plants, embodying the Perkins Diesel engine, will now be continued by F. Perkins, Ltd., to whom inquiries for such plant, as well as for hand-controlled generating sets, from 12 kW to 60 kW, should be addressed.

Mr. C. H. Woodward, the Bournemouth electrical and public lighting engineer, is to retire on superannuation shortly but is to continue to act as consulting engineer at a fee of £25 per annum. **Mr. C. C. Coffin** is to be placed temporarily in charge of the electrical department under the borough engineer.

Mr. E. Williams, mechanical maintenance engineer at the Moredon power station of the Swindon Corporation, is retiring after thirty-eight years' service. He was recently presented with gifts for himself and his wife by the borough electrical engineer (Mr. A. Nicklin) on behalf of the staff of the Electricity Department.

Mr. E. Deakin, of the Huddersfield Corporation Transport Department, is recommended for the position of traffic superintendent by the Ipswich Electric Supply and Transport Committee.

Mr. Walter Abbott, O.B.E., and **Mr. A. W. Ferguson,** M.C., have been appointed members of the Northern Ireland Electricity Supply Board in the place of the late Mr. A. H. Muir and Mr. W. D. Scott, C.B.E. (resigned). Mr. Ferguson is chief administrative officer of the Board.

Mr. H. V. Senior, chief engineer of the Diesel Department of the Brush Electrical Engineering Co., Ltd., has been elected to the board of Petters, Ltd., one of its subsidiaries. Mr. Senior is well known in all branches of internal combustion engineering, having had a wide training and long experience with practically every type of engine. Educated at St. John's School, Wakefield, and Leeds University, he served an apprenticeship with the Campbell Gas & Oil Engine Co., of Halifax, and later worked at Rustons, of Lincoln. During the last war, he was actively engaged on submarine and aircraft engines, and for the last two years of the war, was Deputy Director General of the Egyptian Government Research Works in Cairo.

Mr. H. V. Senior

Mr. Senior has been responsible for the development of the *vis-à-vis* Diesel engine and particularly the Brush engine which is now produced as the Blackstone-Brush engine. He has been a constant contributor as lecturer and author of many papers dealing with the development of internal-combustion engines and their adaptation to the use of all classes of fuel. He is president of the Institute of Engineering Inspection and a member of the Institutions of Mechanical Engineers and Marine Engineers, and of the Institute of Fuel.

Major S. W. Lloyd, M.C., A.M.I.E.E., has now been recalled to the Army as a Deputy C.R.E. (Electrical and Mechanical). He has been employed as a civil servant since leaving the Metropolitan-Vickers Electrical Co.

Mr. F. D'Arcy Cooper, chairman of the Executive Members of the Export Council, is on a short visit to the United States to investigate trade possibilities.

Obituary

Mr. Frank A. Newington, M.Inst.C.E., who was engineer and manager of Edinburgh Corporation Electricity Department for twenty-eight years (retiring in 1924), died at Hove on October 23rd. Mr. Newington in 1896 succeeded the late Mr. E. W. Monkhouse as resident engineer. Under the supervision of Mr. Newington the undertaking made rapid progress. In 1914 the City obtained powers to extend its area of supply to include neighbouring districts, and the amalgamation with Leith extended operations further and brought a third station under the Corporation's control.

Mr. H. T. Tilley.—We regret to announce the death on October 28th, at the age of fifty-three, of Mr. H. T. Tilley, manager of the London Engineering Department of the General Electric Co., Ltd. Mr. Tilley joined the G.E.C. thirty years ago and for the greater part of that period was chief assistant to the late Mr. J. Mercer, after whose death in March last he succeeded as manager. He leaves a widow, a daughter and two sons (both G.E.C. employees now on active service).

Mr. O. H. Adamson.—We regret to record the death, on October 18th, of Mr. O. H. Adamson, B.Sc. (Tech.), A.M.I.E.E., and his wife, by enemy bombing action. Mr. Adamson, who was the son of Mr. G. L. Adamson, of Rochdale, well known in the electrical contracting industry, was educated at Ackworth School, Yorkshire, and the Manchester College of Technology. He received his practical training with the Metropolitan-Vickers Co., the Rochdale Corporation and the Manchester Corporation. For the past eight years he had been on the staff of the Central Electricity Board, the first part of the time being spent in the North-West England District and the latter period in the South-East and East England District, where he was employed as an assistant technical engineer.

Mr. S. E. Smith.—We regret to record the death of Mr. Sydney E. Smith, chairman of Oliver Pell Control, Ltd., which occurred at his home at Bray on October 27th following a short illness.

Mr. Edward L. Griffey, a well-known local electrical contractor, died at Bath recently at the age of sixty-one.

Wills.—**Col. R. E. B. Crompton,** C.B., F.R.S., left unsettled property already valued at £15,329, which with settled land now valued at £13,000, makes the total value of property passing at his death £38,329.

Mr. H. V. Baughan, of Caversham, Reading, retired electrical engineer, left gross estate of £9,503 with net personalty £8,329.

ARTIFICIAL RUBBERS

Production and Properties of Different Varieties

MOST materials used by man are natural products, merely refined after collection, or otherwise adapted to his needs. By contrast "plastics," of which more than six hundred are trade-marked, are not found naturally in any form; they are man-made and the process cannot be reversed, or the ingredients turned back into their original components.

This synthesis consists in the compounding of common substances mixed with a catalyst (merely assistive chemically, itself remaining unchanged and sometimes recoverable for further use) and heated to induce a non-crystalline precipitate which, with the aid of accelerators and conditioning agents, can be moulded to the required form. The chief distinguishing component is an organic "binder" of the "filler" mass which at some intermediate stage of its production must be plastic or liquid, respectively capable of being shaped or cast, rigidity being induced at some subsequent stage.

Frequently, though not always, the final state is brought about by a rearrangement of molecules in either of two ways. Their linking together may be accompanied by the elimination of elements (such as hydrogen) or of molecules (such as those of water or hydrochloric acid) which is a condensation reaction. Alternatively, single molecules may be linked to form larger molecules without any change in chemical composition, which is a true polymerisation reaction. This term, which is often misused, is applied to the actual change that causes the union of two or more molecules of the same substance to form a more complex molecule, which can be resolved on heating into its components.

Substances are said to be polymeric when the molecular formation of one of them is an exact sub-multiple of that of the others, even when the substances are not mutually convertible into each other. Reversibility distinguishes polymerisation from condensation; it is a marked property of certain groups of chemicals and in some cases is spontaneous at ordinary temperatures. Of two substances of the same elementary percentage composition, but of multiple or sub-multiple molecular weights, that which is of greater molecular weight is known as the polymer of the other.

Dissociation may be electrolytic (recombination of ions) or a thermal equilibrium phenomenon (not decomposition) while polymerisation is a re-association which enables the resultant product to retain the same percentage composition as the original material, yet acquire a (many times) greater molecular weight and so assume very different properties, which can be influenced by variation of the compounding technique.

Classification of Twenty-nine Varieties

This is the process upon which the synthesis of rubber is based. In 1939 nearly 200,000 tons was produced artificially in the United States, Great Britain, Russia and Germany on a commercial scale. In Europe it has been used mostly as a substitute for the natural product, but in America it is employed because it can in some respects be made superior to ordinary rubber for specific purposes. Circular 427, which has been prepared by the National Bureau of Standards (U.S. Government Printing Office, Washington, D.C., price 10 cents) as an attempt to summarise facts and provide a complete bibliography of the literature of the subject, classifies twenty-nine commercial varieties into six types according to chemical composition. Familiar examples are discussed, indicating the raw materials employed, the chemical reactions utilised in manufacture, the general conditions of polymerisation or condensation, and those of compounding and vulcanisation. Their properties and uses are reviewed, published data relative to different types being summarised in comparative tables.

Some varieties may have properties which are superior electrically to those of natural rubber, while in others the presence of polar groups imparts relatively good conductivity, which is being turned to advantage when it is desired to dissipate static charges, for example in hospital operating theatres and tyres on trolley buses and aircraft. It is nowadays possible to make rubber with a wide range of specific resistance, ranging from one to 10^{15} ohms per cm. cube. But it is not possible to endow it with chosen mechanical properties at the same time, for to a large extent the two effects are interdependent, the conducting rubbers all being harder than the insulating variety.

Prolonged research has failed to indicate cheap means of manufacturing isoprene (C_5H_8 compound of carbon and hydrogen only) or of deriving from it a polymer with physical properties close to those of natural rubber. Consequently, all commercial synthetic rubbers differ chemically from the natural product though there is resemblance between physical properties.

In Circular 427 artificial rubbers are listed under their German, American, Belgium, Polish, Japanese, Russian and English manufacturers' trade names; some are described as practically identical and others are said to be very closely related to each other. In common with natural rubber, all types made artificially consist of atomic chains of very great length, or giant molecules built up by repetition, usually thousands of times, of some unit configuration. In all but two of the cases cited the long chains are "forged" by the polymerisation (linking together) of the molecules of liquids. In the process of formation of the polymer from the liquid monomer (denoting that the element or group occurs only once in the molecule of the compound) in each case the double bond attached to a carbon atom at the end of the molecule opens to form the necessary valence bond for attachment to the next unit. Valence is the capacity of an atom to combine with other atoms to form a molecule. It is specified as the number of hydrogen atoms, or twice the number of oxygen atoms with which one atom of the element in question will combine.

Two examples of long chains formed not by polymerisation but by condensation are organic polysulfide rubbers. The atoms at the ends of two different molecules combine with each other, thus leaving the remaining radicals free to combine; long chains are formed by the repetition of this process. Not in any one case of the different varieties has the nature of the terminal group of the chain been definitely established. It comprises only a very small fraction of the total material and may be different in different chains of the same material.

Stages in Synthesis

Rubber synthesis proceeds in two steps. The first is the manufacture of the monomer, mostly by fairly common and well-understood reactions; the second step is more empirical and less understood but usually involves the use of a catalyst and the control of temperature and pressure.

One of the most important of recent advances has been polymerisation in emulsion. The monomer is emulsified in a liquid, usually water and the product is a suspension similar to the latex of natural rubber. Another helpful step forward is co-polymerisation, whereby two or more liquids are caused simultaneously to yield a product in which a single chain contains units of both configurations.

In most cases synthetic rubbers cost at least three or four times as much as natural rubber, but price is offset by general superiority in some respects outstanding. The artificial varieties are better able to resist the deterioration caused by ageing due to exposure to light, heat, ozone and oxygen. Their permeability to gases and liquids, especially petroleum products, is less, partly because of the absence of proteins and other non-hydrocarbon constituents and partly to differences in structure. Some of them burn less easily than rubber and are able to absorb more energy, which property is useful for rapidly damping vibration, but may cause tyres to overheat.

Emulsion polymerisation yields a latex containing particles which are smaller and more nearly uniform in size than the natural sort, which is helpful when the latex is required to penetrate into fine pores. Decomposition is avoided because this kind of latex does not contain organic impurities subject to putrefaction through bacterial action.

No single type of artificial rubber can present outstanding advantages in all fields of application. Possibly no individual type will ever be so widely applied as the natural product, but collectively the synthetic varieties offer marked advantages by reason of the diversity of properties they possess. Some

kinds are cheaper to make than others and for any specific purpose it is invariably possible to select a particular variety which excels in certain respects. The only types claimed to exhibit superiority in respect of purely electrical properties, however, are said to be "Vistanex" (Standard Oil Co., U.S.A.) and the several kinds of "Buna" (I.G. Farbenindustrie, Germany). They are being employed for insulating wires and cables. For other purposes, especially at low voltages, such varieties as "Neoprene" (E. I. du Pont de Nemours & Co., U.S.A.) and "Thiokol" (Thiokol Corporation, U.S.A.) and "Koroseal" (B. F. Goodrich Co., U.S.A.) may also be utilised as insulation materials, although they are more widely favoured in the form of jackets over natural rubber insulation in order to protect the latter against the effects of light, air, ozone, oils and other deteriorating influences. It is stated that many types of cables are being covered with a synthetic rubber jacket in place of the customary lead sheath, also "Koroseal" is especially applicable to the impregnation of fabrics, being obtainable in an extremely wide range of colours and having better ageing qualities than the natural substance.

The organic polysulfide known as "Vulcaplas" originated in England, being manufactured by Imperial Chemical Industries, Ltd., which is now also making "Neoprene" in this country. The latter is reputed to be the most commercially successful type, being made in the following way. The addition of water to calcium carbide (derived from coal and limestone) generates acetylene gas which is polymerised to mono-vinyl acetylene and, by treatment with hydrochloric acid, converted into chloroprene. This is a thin liquid when freshly prepared, but it will not normally remain in this state, changing rapidly to a plastic solid closely resembling rubber. Though its chemical structure is changed entirely the intermediate vinyl product retains the same percentage composition as acetylene, as does the chloroprene, but with the added elements of hydrochloric acid.

Production of Butadiene

Butadiene, alone or in combination with other things, is the source of almost all the rubber substitutes manufactured in Europe. It is a gas at temperatures above minus 5 deg. C. and is obtained by the pyrolysis ("cracking") of petroleum, or converted from alcohol (in Russia by the fermentation of grain and potatoes). The "Bunas" are made on a factory scale in the following manner. A piece of iron wire gauze is cleaned by immersion in acid; it is then coated by dipping into metallic sodium (the catalyst) in the fused state, and this layer is protected by an overcoating of paraffin. The whole is then suspended in an enamelled sheet iron drum that is placed in an upright cylindrical autoclave which is jacketed for steam heating and brine cooling. Butadiene is admitted to the vessel, which is then closed and heated to 30 deg. C. at which temperature the polymerisation process commences. Since the reaction is exothermic, the temperature rises to about 65 deg. C. without aid from the steam jacket; in some cases it is necessary to cool by circulating chilled brine through the jacket. The polymerisation proceeds for nearly five days, the vapour pressure within the autoclave being maintained at about 112 lb. per sq. in. by appropriately heating and cooling it. A spontaneous drop in temperature denotes the end of the reaction, test samples of the vapour indicating the quality of the product.

Pure butadiene is difficult to make, hence the expense of this method. It may be possible, by substituting hydrogen for hydrochloric acid, to derive it in a similar manner (from coke-lime-calcium-carbide-water-acetylene) to chloroprene, which polymerises more rapidly than butadiene and any of its derivatives. The leading representative of chloroprene polymer products is "Neoprene" which, when heated, undergoes a permanent change that simulates the vulcanisation of rubber. Chloroprene is unique among rubber-producing substances in that the polymerisation process can occur without the aid of other materials although in commercial practice compounding ingredients are found to be desirable. They are mixed by means of the usual rubber working machinery, but milling behaviour differs somewhat. While the existence of an established technique for working the natural substance has been very helpful, credit for the successful establishment of the synthetic rubber industry must be apportioned somewhat more to engineers than to chemists, for the latter's processes might not have progressed beyond the laboratory stage if the former had not been able to design equipment capable of dealing in bulk with substances of very low boiling point without excessive loss by evaporation, or constructing machinery of special alloys to resist corrosion.

French Reconstruction

Dock and Railway Schemes

By D. J. Tynan-Byrd

IT is learned from authoritative sources that an elaborate plan of constructive works is to be commenced in France, both in occupied and unoccupied territory, particular attention being paid to the port of Marseilles. It is intended to make this harbour the most important in the south of France and capable of dealing with the entire shipping of the French Empire, estimated to be a total of 25,000,000 tons. A programme of development of the dock facilities, announced recently by M. Bertholet, Minister of Communications, is in hand; it is expected to cost 420,000,000 fr. and it is hoped will be completed in about three years.

In order to improve means of access to Marseilles, a network of new motor-roads from the interior of the country is to be constructed and a large railway electrification scheme is to be commenced. This will, no doubt, be a continuation of the electrification plan which was started in 1932 and was held up by the outbreak of war. The scheme, it is reported from the French Ministry of Production, will give employment to over 20,000 workers for a period of about four years and the cost is estimated to be of the order of 6,000,000,000 fr. The original policy of this plan was to transport energy in bulk from regions where it could be generated economically, *e.g.*, water-power, to regions where it could be utilised and there is reason to believe that this policy will be continued.

In France, generating stations are mainly situated in the areas near the Alps, Pyrenees and on the Rivers Rhône and Garonne on account of the excellent facilities which are available for the building of hydro-electric stations. Steam is only used in the northern parts of the country where the French coal-fields are situated. Overhead transmission lines are employed and the steel towers are of many interesting designs. The standard voltages employed on the system are 90 kV, 150 kV and 220 kV, at a frequency of 50 cycles, three-phase.

It is hoped that by embarking on these schemes of reconstruction and development, impetus will be given to trade and commerce, and that an industrial revival will result.

A correspondent reports that the Vichy Government has allocated 25 milliards of francs for public works, including electrical developments. The S.N.C.F. has decided to electrify the Paris–Lyon railway line, drawing power from the Genissiat hydro-electric plant. The Brine–Montauban line is also to be electrified and the Bordeaux–Nimes electrification completed. This work was stopped by the war.

Another interesting allocation is 750 million francs for the electrification of canal locks. This work was started several years ago, the first important locks to be electrified being at Surennes. The extension of electrification will cover all the more important rivers throughout the country.

About three years ago Paris saw the last of its trams. Even suburban services were replaced by buses. Petrol shortage has now taken the buses right off the roads. The Germans will not allow the buses to run and the only passenger transport available is the Metro. The T.R.C.P. experimented with trolley-buses a few weeks ago and the results were quite satisfactory. It will be some months before the trolley routes are completed, so experiments are now being carried out with coal gas. Before the end of the year, however, it is hoped that trolley-buses will be serving the suburbs. It is unlikely that they will be used inside Paris.

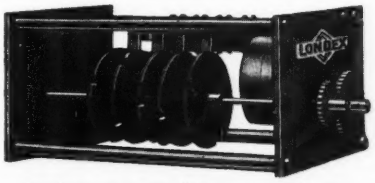
The electrical industry has more or less been lost to France through the German occupation. Both the east and north, where some of the most important factories are situated, are in German hands. There are, however, a few electrical appliance manufacturers in the south, like Merlin and Gerin, who continue to work under Government restrictions. The most important of these restrictions relate to the making of new articles. The Ministry of Commerce and Industry has now decreed that owing to raw material shortage manufacturers must first submit designs and particulars in order to receive an "Industrial Warrant," which will only be issued if the Ministry is satisfied that the production is essential and the raw materials required are available.

NEW ELECTRICAL PRODUCTS

A Review of Equipment Recently Marketed

Process Timer

THERE is now being manufactured by LONDEX, LTD., Anerley Works, 207, Anerley Road, Sydenham, London, S.E.20, a type of process timer switch which can be seen from the illustration to consist of a synchronous motor-driven shaft with



Synchronous motor-driven process timer

five cams and suitable quick "make" and "break" contacting arrangement.

The gear wheels between the motor and cam shafts are easily interchangeable in order to suit various working conditions. If a large switching capacity is required, each set of contacts is then made to control a Type LQA relay fitted with a 20- or 50-A mercury switch. All component parts are mounted together on one panel.

These process timers are supplied with up to 14 sets of cams and either silver or tungsten contacts. Because of the interchangeable gear wheels they can be used in factories when the speed of the complete process has to be varied according to prevailing conditions.

Torpedo Switches

Small torpedo-shaped switches of the through-wiring pattern, which have hitherto been in the competitive range of goods imported, are now being marketed by BARRIES ELECTRICAL AGENCIES, Gladstone Crescent, Hove, 4. They are British made, of bakelite. The "400" size is turned out of a solid rod, with push-bar operating mechanism, and at the moment is available only in mottled silver. The slightly larger "1319" size, which is offered in brown, black, or white, has a slide-forward switching action for thumb operation. The firm also undertakes to quote, against specific inquiries, for turned bakelite parts for the fittings trade.

Emergency Battery Lamp

A battery-operated lamp for emergency uses which is intended to be hung on a wall and is fitted with a carrying handle for portability, a product of the EASCO ELECTRICAL SERVICE, 1, Brixton Road, London, S.W.9, was recently described in these columns. In addition to model FTC.440 which weighs 22 lb. there is now offered model EMA/Tc.20 which weighs 6.5 lb., the dimensions of the metal case being 3 in. by 3 in. by 8 in. in height. It likewise incorporates a "dry" accumulator and a trickle charger, but the latter is not removable like that of the larger size, while the "on-off" switch is fitted at the top of the casing instead of at the front. The lamp reflector is surface mounted and the casing is all-black crinkle finished.

"Easco" trickle-charged battery lamp

Shelter Safety Switch

It is generally recommended that electricity should be supplied to air-raid shelters through step-down transformers, not exceeding 25-V output, while 12 V is commonly used.

If properly safeguarded, higher voltages would permit heating and cooking as well as lighting. But no system of wiring, however well installed, is proof against a nearby explosion breaking the intake cables so rapidly that the fuses have not time to "blow." Under such circumstances the cables would remain "alive" and might entail serious consequences.

This risk is minimised by the installation of a "Setag" safety switch, which has been devised by CHARLES GATES (1939), LTD., Foundry Bridge Works, Prince of Wales Road, Norwich. Its AC rating is 15 A at 230 V, for fitting inside the house as near as possible to the main switch. Thence the shelter wiring is taken out in the usual manner, four cores being needed. The primary (load) circuit is completed from the mains in the house through a tilting mercury cut-out and the secondary (control) circuit through the second pair of wires, so as to energise electro-magnetic solenoids which pull down the mercury switch rocker arm into its "on" position. Breakage of any one of the four wires will de-energise the solenoids, thus releasing the mercury tube, which tilts back into its "off" position by gravity. There is a pull-cord attachment for "making" the circuit initially.

The "Setag" switch is obtainable in a

"Setag" magnetic-mercury safety-switch for shelter wiring

teakwood case complete with a manual double pole isolator and single pole fuses for both load and tripping circuits. The pair of control wires need only be of sufficient size to carry the 30 mA taken by the electro-magnet.

Electrode Manufacture in India

Utilising Local Materials

SOME details of the production of graphite electrodes in Mysore were given in a recent issue of *Indian Engineering*. The Mysore Paper Mills require graphite electrodes for electro-thermal and electro-chemical work and upon the outbreak of war the question of the continuance of supply had to be considered. Accordingly, representatives of the Paper Mills, the Mysore Iron and Steel Works and the Power and Lighting Superintendent of the Kolar Gold Field met to discuss means of ensuring a supply.

The most suitable material for the production of these electrodes is a carbonaceous material containing a minimum proportion of ash and volatile matter. In America, a petroleum coke product is commonly used. Other possible substances are anthracite, retort carbon, pitch coke, wood charcoal and graphite. Of these it was considered desirable to select some local material of the required purity. Two kinds of charcoal—Dindiga and Yetta—were considered, but they were found to contain large proportions of ash and it was therefore decided to experiment with charcoal made from coconut shell and with petroleum coke.

As the investigations were likely to take some time it was decided to meet immediate needs by making electrodes from a good variety of natural graphite. Natural Ceylon graphite which was available from stock was cleaned, pulverised and pressed in a special apparatus constructed by the Iron and Steel Works, and the electrodes were baked in an electric furnace; larger sizes were baked in a coal-fired furnace. The materials obtained were satisfactory to meet immediate needs and the cost was reported to compare favourably with the electrodes purchased by the Mills. The electrical and mechanical qualities were also said to be good. As the alkali chlorine plant had to be brought to full working condition it was recommended that the production of natural graphite electrodes should be continued until the required quantity was supplied.

The question of utilising local carbonaceous materials and graphitising them is still being pursued. Although about half-a-dozen trials have been made the results have not been satisfactory owing mainly to the difficulty of attaining the very high temperature required for graphitisation. Only during one run, which was continued for six days, was a fairly high temperature obtained and the resulting electrode, which was completely cracked, showed indications of having been partially graphitised. Further attempts are being made to attain the required temperature and at the same time the question of grinding and mixing different proportions of ingredients of different degrees of fineness is being actively investigated, so as to avoid the large number of cracks which appear after they are baked.

New Light Alloy

ANOTHER light alloy, which is described as non-magnetic and non-sparking as well as capable of being welded electrically and brazed and soldered, is being marketed by the Colonial Alloys Co., of Philadelphia, U.S.A. The metal has an ultimate tensile strength of about 32 tons per sq. in. with good forming and drawing qualities. It is rustproof and has a chromium-like appearance when polished.

COMMERCIAL and INDUSTRIAL NEWS

Purchase Tax Decision. Automobile Electricians. Machine-tool Appeal

Torch Battery Imports

TO ensure adequate supplies of torch batteries during the winter, the Board of Trade has arranged to licence a certain quantity of imports. While home production and imports should be sufficient to meet the demand, as estimated from experience, the Board of Trade desires to urge the desirability of economy in the use of torch batteries. In the national interest it is still desirable to limit imports, which must be paid for in dollars and take shipping space required for war supplies, as much as possible. The number of batteries needed, the Board points out, will depend upon the way in which torches are used. Since the intensified air-raids began this year torches have been used much more than is necessary indoors, particularly in shelters. The practice has grown of leaving them alight all night. Torches are not an economical means of permanent illumination. For permanent illumination in shelters and elsewhere more suitable forms of lighting should be used; torches should be used simply as flashlamps. Economy can also be effected by using the larger types of batteries.

The Board of Trade has taken steps to ensure that imported batteries shall be of satisfactory quality. The Torch Batteries Imports Advisory Committee, set up by the trade at the request of the Board of Trade, has undertaken the distribution through normal trade channels of batteries of sound quality to be sold at reasonable prices. Every importer of batteries and every dealer is under an obligation to comply with the Prices of Goods Act (1939). Application of the Act to the torch battery trade will be closely watched by the Central Price Regulation Committee on behalf of the Board of Trade.

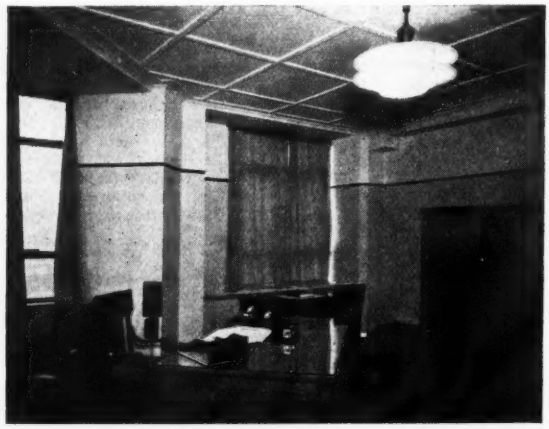
Large New Zealand Installation

The recently erected Government Life Insurance Building, Wellington, is one of the largest buildings in New Zealand, and with one or two exceptions it has been equipped entirely with G.E.C. material.

For the general lighting of the offices where ceiling height permits, bronze chain pendants with enclosed units of various diameters have been installed, while where the ceiling height is low approximately fifty "Dantside" ceiling fittings have been used. The top floor of the building is set back 8 ft. from the principal line, and to provide an added effect during night time, the front and sides of this floor have been floodlit with eight G.E.C. wide-angle projectors. Surmounting the top floor is a tower designed in the form of a lighthouse, in the lantern of which an "Osira" 400-W mercury electric-discharge lamp has been fitted.

Four Express-S.M.S. passenger lifts of the dual control type have been provided for the building. The main lift drive is of the slip ring variable voltage type and comprises Witton 26 BHP slip ring motors operating on 400 V, three-phase, 50-cycle supply with eddy current brake for control of levelling.

In the Government Life Insurance Department, which covers three floors, a G.E.C. 25-line private automatic telephone exchange has been fitted. This provides full instantaneous automatic intercommunication during day or night without necessitating a switchboard operator. An interesting feature on one line is the "Executive's right-of-way." This gives the Commissioner priority so that he can call any departmental officer even when the instrument is already being used. Four separate conversations can take place simultaneously without interference. The telephone system operates from a 24-V storage battery with a permanently connected trickle charger. A complete G.E.C. luminous indicator system has also been fitted for staff calling; altogether there are thirty-six indicator units incorporating seventy coloured lights. The secretary's desk is fitted with an eight-way table push indicator and green lights, facilitating communication with all principal departments via wall-type multiple-way combined lamp and relay indicator units with push-button replacements. This system also operates from a 24-V, 10-A nickel-cadmium-alkaline battery, charged continuously from the 230 V AC mains by a trickle charger. In the internal marketing department a similar but smaller luminous indicator system has been installed, while for the fire alarm system four 10-in. ironclad bells have been supplied for the building.



The Commissioner's room in the Government Life Insurance Building, Wellington (N.Z.)

In addition, twenty-nine "Genalex" synchronous electric clocks, eight miles of conduit with over 4,000 conduit fittings, seventeen miles of Pirelli-General cable, nearly 1,000 "Osram" lamps, over 800 wall switches, 150-15 A interlock switch plugs, nearly fifty triple-pole ironclad switches and switch-fuses ranging from 30 to 150 A in size, together with approximately 500-15 A ironclad fuses, have been furnished by the General Electric Co., Ltd.

Iron and Steel Control

The Minister of Supply has made the Control of Iron and Steel (No. 13) Order, 1940, which came into force on November 1st. Under this Order new maximum prices for iron and steel products are instituted and those laid down in the Control of Iron and Steel (No. 8) Order, as amended by Nos. 10, 11 and 12 Orders, are withdrawn. The new maximum prices fixed under the Order represent an increase of 35s. a ton on billets, sections, joists and rails, and of £2 a ton on plates, with corresponding adjustments in the prices of finished products such as tubes, bolts and nuts and wire. The greater part of these advances in price, as in the case of advances previously made since the beginning of the war, is to meet payments into a central fund which is used to equalise the cost of imported steel and raw materials with the price of similar home products. In particular the need to augment the central fund is the result of the increasing quantities of imported steel now arriving from the United States. Some allowance, amounting to about 5 per cent. on present prices, has been made to meet certain increases in home production costs. Copies of the Order may be obtained from H.M. Stationery Office, York House, Kingsway, London, W.C.2, or through any bookseller.

Auto-Electrical Technicians

The Association of Auto-electrical Technicians, the registration of which was recorded in our issue of October 4th, is not a new association but a continuation, under a new title, of the Society of Automotive Electrical Engineers, which was founded eight years ago. The new title was necessitated by the requirements of the Registrar of Joint Stock Companies on incorporation. The original society had a membership approaching 300, which will be automatically transferred to the new association.

The aims and objects of the original society will be continued by the association, the only difference being in the title. It is a purely technical organisation, covering the electrical side of automobile, marine and aeronautical engineering. Under its articles of association, no matters relating to trading policy may be discussed or published. Branches are established in London, Manchester, Sheffield, Leeds, Hull and New Zealand, while further branches will be formed as soon as a sufficient number of members in any district justifies such a course. Whilst lectures and visits have had to be abandoned during the war, the publication of the *Bulletin* is being continued in order to keep members in touch with one another and with the latest technical developments. The approved abbreviations of the title of various grades of members are as follows: Hon. members, Hon. M.A.E.T.; members, M.A.E.T.; associate members, A.M.A.E.T. In addition there are grades for companions and junior members of the Association which do not carry any title but include all the technical privileges enjoyed by other members. Full particulars may be obtained from the Secretary, Mr. C. C. Feldman, A.C.A., 84, Northumberland Road, New Barnet, Herts.

Purchase Tax Arrangements

The Commissioners of Customs and Excise announce that they are prepared to accept an arrangement whereby registered persons habitually buying goods as stock or materials may furnish a general statement to the seller covering all their purchases during a stated period not exceeding six months. This arrangement may be adopted as an alternative to the requirement of a particular statement on each order described in paragraph 6 of Notice No. 77.

A letter in the following terms addressed to each supplier concerned will be regarded

as satisfactory for this purpose provided it is signed by the proprietor of the business if an individual, by a partner in the case of a private firm and by a director or the secretary in the case of a limited company.

DEAR SIRS,

Purchase Tax.

As required by Section 24 (1) of the Finance (No. 2) Act, 1940, we hereby certify that we are the holders of Purchase Tax Registration Certificate No. .....

We authorise and request you to invoice to us any goods liable to Purchase Tax which are supplied to our account within six months of the date of this letter without the addition of the amount of such tax, save where we notify you to the contrary in respect of any particular transaction. We intend to use all goods so supplied as stock for sale or as materials in manufacture. In the event of their being appropriated to retail trade or to other taxable purposes, it is understood that we will be accountable to the Crown for payment of tax thereon.

Yours faithfully,

(Sd.) .....

Date.....

This letter must be retained by the supplier for production on demand to the proper officer of Customs and Excise. Unless the transaction is covered by a specific order in the terms of paragraph 6 of Notice No. 77 or a general letter in these terms, the seller is legally accountable for tax on the purchase.

Purchase Tax on Electric Clocks

In a circular letter to all approved synchronous clock wholesalers the British Synchronous Clock Conference states that by agreement with the Customs & Excise Department the Purchase Tax that is to apply to Conference clocks is to be as follows :—(*a*) On synchronous clocks up to and including 39s. 6d. each (list price)—tax 23 per cent. of the manufacturers' current list price ; (*b*) on synchronous clocks exceeding 39s. 6d. each (list price)—tax 22 per cent. of the manufacturers' current list price. All members of the Synchronous Clock Conference will be operating accordingly.

Machine-tool Week

To ensure that every possible machine tool is working to its full capacity in the national war effort the Ministry of Supply is making a special appeal this week to engineering firms to part with those which are not likely to be used for essential work. At the same time the Ministry is repeating the machine-tool census made three months ago, so as to have the most up-to-date information regarding the effects of bombing, &c., on the use of the tools and to make certain that not a working minute of the capacity of any in the country is wasted. As Mr. P. H. Mills, Controller of Machine Tools, Ministry of Supply, points out, this is a war of machines and the machine-tool industry is facing the problem of furnishing a tremendously increased volume of machine tools both to Government establishments and essential industries. A large supply of machine tools has been acquired in the United States, but in considering the help that we can get from that country we have to bear in mind their own rearmament programme. The results of the appeal made by the Ministry of Supply a few weeks ago have been very satisfactory and large numbers of machine tools have been purchased and put into use.

Aluminium Specifications

To meet a widely felt need, the technical staff of the Northern Aluminium Co., Ltd., has compiled a fully classified summary of current D.T.D. and B.S. specifications relating to aluminium and aluminium alloy products. The number of such specifications is relatively large and the booklet, which is of a convenient size, has been compiled in order to provide ready reference by technical personnel in the numerous manufacturing concerns now working for the first time on light alloy materials to standard specifications.

The full range of British light alloys as specified at present is classified according to the various forms in which each is produced, namely, ingot, sheet and strip, bars and sections, tubes, wire and rivets, forgings and castings. The appropriate specifications are shown under each heading, with the proprietary nomenclature and tables of chemical composition and mechanical properties. A tabulated summary of proprietary alloys in alphabetical order, showing the corresponding specifications and the forms of material to which they apply, is also given.

Copies may be obtained gratis by applying to the Research and Development Department, Northern Aluminium Co., Ltd., Banbury.

Apparatus Approval in Australia

What is apparently the first prosecution under the New South Wales law requiring official approval of certain electrical equipment is reported by the Australian *Merchandiser*. The defendants were charged with offering for sale an electric radiator and hand lamps which were not properly marked. The law provides that "any class, description or type of electric wire, cable, appliance, fitting, meter, insulator, etc.," may be brought within the provisions of Section 512A of the Local Government Act. Before any scheduled articles can be sold, hired or advertised or exposed for sale or hire they must comply with the relevant published specification issued by the Standards Association of Australia and carry a registered guarantee number or marking authorised by the Electricity Advisory Committee.

The following list of articles so far scheduled is given by our contemporary :—Bread toaster, griller, radiator, portable immersion heater, kettle or saucepan, jug, iron, earth-leakage circuit-breaker, plugs and sockets, wall switches, soldering iron, apparatus connector, normal bayonet lampholder adaptor, cord extension socket, razor, miniature over-current circuit-breaker, hand-lamp and plug socket adaptor.

Electrician's Pocket Book

The 1941 edition of "The Practical Electrician's Pocket Book" (*Electrical Trading and Radio Marketing*, 92, Long Acre, W.C.2, 3s. net) contains a good deal of new and useful information. A chapter summarises the new lighting regulations while the chapter on lighting has been extensively revised in view of changes in lighting design consequent upon the black-out and the need for speed in production. A new section on radio has been introduced dealing with principles and servicing while among the many sections which have been revised is that giving the supply voltages. There has also been extensive revision and regrouping of the introductory reference data and tables while a longer and more detailed index is included.

World Tin Production

According to the October issue of the International Tin Research and Development Council's Statistical Bulletin the world production of tin in September is estimated at 22,600 long tons, compared with 19,100 tons in August. The total for the first nine months of 1940 was approximately 167,400 tons, against 111,300 tons in the corresponding period of 1939.

The United States deliveries totalled 81,814 tons in January-September, 1940, against 46,620 tons in the corresponding period of 1939, showing an increase of more than 75 per cent. This year's deliveries include tin acquired for the emergency reserve stock. World stocks of tin, including smelters' stocks and carry-over, increased by 1,592 tons during September to 52,824 tons. World stocks at the end of September, 1939, were 39,398 tons. The average cash price of standard tin in London was £251.3 in September, 1940, against £262.6 in the previous month and £229.4 in September, 1939.

Trade Announcement

Ellison Insulations, Ltd., announces that changes at its works due to expansion of business have made it necessary for the offices of its Midland area engineer to be transferred from the works to 36, Bennetts Hill, Birmingham, 2 (telephone : Central 5651). The new offices were opened on November 4th and inquiries regarding "Tufnol" from users in the Midland area should be sent to this address. The Midland area will continue to be managed by Mr. E. J. Reynolds, with Mr. W. G. Phelps as resident engineer for Wales.

Changes of Address

The London office of Santon, Ltd., has been removed to "Inglecroft," Southwood Gardens, Esher, Surrey (telephone : Emberbrook 3370).

The Publicity Department of the Edison Swan Electric Co., Ltd., has been removed to 18, York Street, Twickenham, Middlesex (telephone : Popesgrove 1144 (extension 1)).

New Catalogues and Lists

Glenfield & Kennedy, Ltd., Kilmarnock, Ayr.—Illustrated booklet technically descriptive of hydraulic valves of specialised types designed for manipulation at the higher pressures used in water and oil-operated mechanisms.

Benjamin Electric, Ltd., Tariff Road, Tottenham, London, N.17.—Illustrated leaflet recommending illumination values for different factory operations and the value of light meters.

E. R. Briggs, 17, Lawford Road, Rugby, Warwickshire.—Leaflet descriptive of the "Brig" two-wheel lifting hand-truck for internal transport.

INFORMATION DEPARTMENT

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the following :—

STELLEX heater for sealing cellophane.

Trade Mark Application

Among recent applications for British trade marks is the following, objections against which may be entered within one month of October 30th :—

Desmo, No. 612,595, Class II (IV). Lamps for vehicles, lamp brackets (not being parts of vehicles), stoves, portable heating apparatus, lamp masks, lamp shades, lamp shields and rear reflectors for motor vehicles. Also No. 612,596 (IV). Direction indicators, horns, etc., all for vehicles. Desmo, Ltd., 31, Stafford Street, Birmingham, 4.

THE MANUFACTURER'S ORDER BOOK

Problems Raised by "Priority"

By "Sala"

ALMOST every manufacturer of materials required in the war effort has asked himself, when orders have been swamping him, "Should I refuse further orders for the time being or should I limit the acceptance of orders so as to bring them into line with my estimated output?" The answers to these questions are extremely difficult to give. Manufacturers are told that priority is expected for orders which specify the Government contracts for which the material is required, but when the majority of the orders received specify Government contracts, what can be done about it?

If the manufacturer approaches each of his customers to endeavour to obtain some guidance as to the urgency of their requirements he will achieve little success, as every customer rightly demands preference and feels that he should get it in view of the material being required for urgent Government work. It is nearly impossible to decide the order of priority, for all customers are engaged on work which is directly or indirectly concerned with war production, and it may happen that material ordered through the usual trade channels is required for some vitally important part of the war effort and demands priority over orders received direct from Government Departments.

Rationing Supplies

It would appear that the only safe and sure way in which the manufacturer can satisfy the demands is to so ration out his output, as to supply a portion of each customer's requirements. This obviously means an order book overflowing with part-delivered orders and brings in its train disorganisation, inconvenience and a great deal of extra clerical work which, with present short-handed office staffs, he could well do without. Nevertheless, he has to console himself with the fact that part-satisfied customers will, at least, outweigh the disadvantages.

This rationing of supplies by no means solves his difficulties and orders continue to pour in at a rate often in excess of his output, with the result that his total incomings represent the output of weeks or even months. He realises the inadvisability of refusing orders, particularly as he has no means of authenticating their vital importance in comparison with the uncompleted priority orders still on his books. He feels that the responsibility of limiting or reducing the amounts specified in a customer's order is heavy and that he alone cannot be expected to know whether or not the reduced amount may be useless for the customer if he wishes to complete an urgent job of vital necessity. Manufacturing processes are carefully checked, output is increased wherever possible, new methods are tried and his whole factory is speeded up in the hope that he will be able to beat the overwhelming balance by which orders exceed output. He feels that he can justifiably refuse to supply any new accounts and confine his business to his regular customers, but if he refuses to accept an order from a new customer he will probably find that it will eventually come back to him through one of his regular merchant customers.

Too Many Inspectors

Visits by inspectors representing Government Departments give the manufacturer an opportunity of explaining his difficulties and enable him to glean useful advice as to the priority to be given to certain orders, but it must not be overlooked that these gentlemen each represent a particular Department and all that concerns them is the satisfying of that Department's requirements. Some large firms are now employing inspectors in a similar way with the result that the manufacturer spends half his time interviewing inspectors who cannot do anything to assist him or offer him any guidance except to insist that the requirements of their Department or firm must have preference.

The problems of manufacturers differ, but it is a well-known fact that commodities are being used and purchased in large quantities for purposes for which they were never intended and for which they are quite unsuited. Some clever but not very far-sighted salesman got the idea at the commencement of the war that such and such a material would make an excellent black-out. Granted, the price would be very high, but people would pay any price to obtain an effective black-out. That same material may be, let us say, an insulating medium in common use in the electrical industry. In such circumstances the patriotic manufacturer, when pressed for delivery of his material from firms in the electrical industry engaged on important war work, would weed out the customers who were purchasing only for black-out purposes and refuse to supply them. Unfortunately, all manufacturers do not think alike and for the indecisions of some the whole industry suffers from insufficient supplies of material. Merchants are often at fault in developing unwelcome markets for materials, but this action can be excused. In normal times the manufacturer expects the merchant to develop new markets but he should not hesitate to fully explain the necessity of discouraging new markets now.

All regular trade customers should be made fully aware of the manufacturer's problems. Part deliveries lead them to assume that if delivery of their orders is so extended it is advisable for them to immediately place a further order so that they may be assured of, at least, some regular deliveries. If they would only explain to the manufacturer the reason for booking these additional orders his task would be greatly simplified and he would appreciate the information, as it would permit him to so forecast his production as to be able to give the customer some idea when delivery could be expected instead of having to rush the material through due to false statements of the urgency.

Planned Purchasing

There are still too much hand-to-mouth business and rush orders which are quite unnecessary if the purchaser would only appreciate the manufacturer's problems and plan his purchasing so that as much reasonable notice as possible is given when supplies will be required again. When he realises that every other purchaser is ordering and expecting three or four times as much material as he purchased in peacetime and that, apart from this extra business, the manufacturer is being encouraged to handle every piece of export business he can lay his hands on, then he will have some little insight into the difficulties to be overcome.

Whilst buying during the past twelve months has not been panicky it has certainly been heavy, and it is felt that it has been heavy because of a mistaken idea that to have the material on order was to be assured of delivery. It has even been suggested by some manufacturers that if their customers refrained from sending further orders for a period of a month or so, assuming that their buying has been intelligent, it would be to the benefit of both customer and manufacturer. Outstanding orders could be brought fairly well up to date and re-ordering, based on output, carried out with an estimated delivery to the reasonable requirements of all customers.

Discharge Tube Protection

A DEVICE for automatically and immediately disconnecting a faulty luminous sign is described by Mr. E. A. Fowler in the *Electrical Supervisor* for September. Investigations by the author have shown that trouble is most frequently caused by open circuits in the tube due to fracture or by failure of gas. In such conditions the oscillations caused by attempts at re-striking set up high-frequency surges which, if continued, lead to breakdown, but partly because of the high reactance of the transformer the current passing in the secondary circuit is insufficient to blow the fuses in the primary. The device consists of a circuit breaker in the low-voltage connections which is held closed by a fusible element in a spark gap on the high-voltage side. A dangerous rise of voltage causes a spark to jump across the gap, melt the element, and thus open the breaker.

Assuming that from 7,000 to 8,000 V is required to maintain the arc under healthy conditions, the 10,000 V required on striking does not operate long enough to give rise to a spark. If, however, such a voltage lasts for half a second or more the gap sparks over. As an additional safety measure, earth leakage protection can be provided by a relay coil inserted at the nodal point of the transformer secondary winding.

ELECTRICITY SUPPLY

Chester Loan Application. Mountain Ash Gift to Consumers

Bethesda.—PRICE INCREASE.—The Urban District Council has raised the lighting flat rate from 3d. to 4d. per kWh, but the power rate will remain at 1d.

Blackburn. — ADVISORY BOARD TO REMAIN.—It was reported to the Town Council recently that the Electricity Commissioners had decided for the time being not to proceed further with the question of disbanding the Mid-Lancashire Electricity Advisory Board. At its previous meeting the Council had directed the town clerk to inform the Commissioners that it was in favour of disbandment.

Bolton.—NEW SWITCH-HOUSE.—The Electricity Committee has obtained sanction to borrow £3,680 for the erection of a switch-house at the power station.

Cardiff.—SHELTER HEATING.—The city electrical engineer has reported to the Emergency Committee that the cost of providing heating installations at public and communal shelters to give a temperature of 60 deg. F. would be £16,500 and to give 50 deg. F., £14,000. The running cost for 60 deg. F. would be £17,000 per annum (without making any allowance for economies which could be effected by manual control as it was impossible to estimate the hours of use) and for 50 deg. F. £11,500 per annum (assuming thermostatic control at this figure throughout the winter season and that doors and screens would be provided to conserve heat).

Cheltenham.—SUB-METERS. — The electrical engineer recently reported that hitherto it had not been the Department's practice to allow consumers to have sub-meters when they let part of their premises to temporary residents, but in the existing circumstances he recommended that sub-meters should be installed in approved cases, the meter rent to be increased to 1s. 6d. per quarter for meters up to 5 A and to 2s. a quarter over 5 A and a connection charge of 5s. made for each sub-tenant. The Electricity Committee approved this proposal.

Chester.—COMMISSIONERS SEEK INFORMATION.—Replying to the Corporation's application to borrow the sum of £12,000 for expenditure on unspecified mains and services, the Electricity Commissioners have decided to sanction £8,000 pending the receipt of further information as to the nature of the demands which the Council anticipates it would be necessary to meet, or as to the grounds on which the Council regarded the estimated further expenditure as being of pressing necessity. The Commissioners have agreed to sanction the borrowing of £8,999 (mains £5,760 and plant, transformers, switchgear, etc., £3,239). Further information is asked for with regard to the amount of £1,625 for spare transformers for A.R.P. purposes.

Glasgow. — MAINS EXTENSIONS. — The Electricity Committee is to extend the mains to supply Glass Fibres, Ltd., at a cost of £896 and Harland & Wolff, Ltd. (£451).

Kettering.—WATER-HEATERS IN COUNCIL HOUSES.—The Kettering Gas Co. recently reported to the Town Council on the results of an inspection of the whole of the geysers on the Council's Stamford Road housing estate. It was stated that 83 were worn out, 208 needed attention, 20 were not in use but usable and 110 geysers had been removed since the last inspection. Seventy-one houses had electric geysers, 39 had been fitted with pumps from electric coppers, and two houses were without means of heating. The Council decided that where geysers were worn out the tenants should be asked whether they preferred gas or electricity for water heating.

London.—POPLAR.—The Electricity Committee has increased all fixed charges on the contract system by 10 per cent. (i.e., 10 per cent. on the kW charge and 10 per cent. on the rental wiring fixed charge) and is making an additional weekly charge of 3d. for a cooker, 1d. for a water heater and 1d. for a wash boiler.

The Committee has obtained sanction to borrow £3,150 for mains and services, £704 for substation equipment and £2,776 for wiring installations.

BATTERSEA.—The Electricity Committee has obtained sanction to borrow £5,000 for mains and services.

Manchester.—INDUSTRIAL EXTENSION.—The Electricity Committee is making application to borrow £4,000 for additional substation equipment and £5,900 for a 33,000-V feeder cable and pilot cable in connection with an industrial extension (additional electric furnaces). The equipment required is as follows:—One 33,000-V, 400-A, 250-MVA rupturing-capacity duplicate busbar, remote-controlled oil circuit-breaker; one set of feeder protective gear; multicore cable between the control panel and the switch unit; and one 33,000-V, 0.3 sq. in. section, three-core feeder cable and pilot cable, route length, 1,650 yd.

LOAN.—The Electricity Committee is seeking sanction to borrow £9,900 for the provision of feeder cable and substation equipment.

Mountain Ash.—"CHRISTMAS BOX" FOR CONSUMERS.—For some years the Urban District Council, which controls the electricity undertaking of this Welsh mining township, has made a practice of reducing the flat rate charge for the Christmas quarter as a form of gift to its consumers. Despite the war it proposes to do so again this year and instead of charging 2½d. per kWh for lighting (less ½d. discount for prompt payment) the consumers will pay only 1d. per kWh. In the aggregate this will amount to a gift of about £3,000.

Supply Failures

The Electricity Commisioners have informed authorised undertakers that they will not in future require them to send notification of failures of supply to domestic or other premises which have been damaged or destroyed and will not require a supply for some time to come, unless they are important industrial premises or the damage also affects other premises which are in a position to take a supply.

Consequently requirement (5) of No. 21 of the Electricity Supply Regulations, 1937, is superseded by the following new direction: "(5). Failures of supply due to damage to the works of the undertakers consequent upon hostile attack other than (*a*) failures of service lines to domestic premises, (*b*) failures of supply to premises to which supplies could not be readily restored owing to war damage to the premises themselves and (*c*) failures of supply for less than 12 hours (not being due to failures of service lines) to domestic and commercial premises which require, and are in a position to take, a supply."

Scarborough.—NEW TARIFF.—The following tariff for large mixed supplies of electricity has been approved by the Town Council and comes into force immediately:—First 10,000 kWh per annum, 3d. per kWh; next 40,000 at 2d.; next 100,000 at 1½d.; and all over 150,000 at 1¼d.

Southend-on-Sea.—DISPOSAL OF SURPLUS DOMESTIC APPLIANCES.—At a recent meeting of the Town Council consideration was given by the Electricity Committee to letters received from other undertakings inquiring whether the Corporation would be willing to sell to them certain domestic electrical appliances. The electrical engineer was authorised to dispose of a number of cookers, water heaters, and wash boilers at prices agreed by the Committee.

Overseas

Australia. — PROPOSED RECONSTRUCTION OF PYRMONT STATION. — The general manager of the Sydney County Council Electricity Department (Mr. R. Vine Hall) recently submitted a report covering recommendations for future increases in generating capacity. Tenders have been invited for an additional 50,000-kW turbo-alternator for the Bunnerong station to cope with the demand in 1943, and Mr. Vine Hall considers that further plant capacity of approximately 50,000 kW will be required in 1946, 1948 and 1950. According to the *Electrical Engineer and Merchandiser* (N.S.W.) this estimate takes into consideration the assistance in meeting demand which may be obtained from the systems of the Department of Railways and the Electric Light and Power Supply Corporation through interconnections. In order to provide for the additional generating plant required by 1946 and to meet the growth in the demand up to the year 1950, the general manager recommended the erection of new generating plant having an ultimate installed capacity of between 150,000 and 200,000 kW on the site of the Pyrmont power station.

This proposal would involve the complete reconstruction of the existing station and finally the scrapping of the existing plant, which was installed at various times between the years 1921 and 1924. The Council owns the greater part of the area required and the site is at approximately the centre of the system, well located with respect to the transportation of coal. To make full use of the advantages of the site with respect to supplying the demand in the city and North Sydney areas the report recommended immediate attention to the design and construction of a new switch-house at Pyrmont, to be in service by the winter of 1943.

The cost of the reconstructed power station would be, in very approximate figures, £3,600,000 to £4,700,000, depending on the size of the plant, its general arrangement, operating steam conditions, and other technical features. The report recommended that the Council should authorise the expenditure of £402,000 (£15,000 for preliminary work and £387,000 for the construction of the first section of the new switch-house).

In examining this report the Council suggested (*a*) that consideration should be given to power station sites further afield with particular regard to a site at the pit-head of a colliery; (*b*) that the question of the Balmain site should be reconsidered; (*c*) that the national aspect should receive

consideration; and (*d*) that a site in the Grose Valley should be investigated. A report on these aspects is now before the Council and it expresses the following views. Since a station of 200,000 kW would require condenser cooling water at the rate of 160,000 gal. per minute, the only places in the vicinity of Sydney in which sufficient quantities of water are available are the foreshores of Sydney Harbour, Botany Bay, George's River or Broken Bay. The suggestions (*a*) and (*d*) are therefore not practicable unless cooling towers are used. Such an installation would increase the capital cost of the station by at least £1,000,000. The Balmain site is not considered suitable since a railway connection is not practicable and, moreover, is not well situated in relation to the area served. In regard to the national aspect attention is drawn to the report on the supply of electricity in New South Wales made by Messrs. Rendel, Palmer and Tritton, consulting engineers, London. In this the consultants stated that the question of transmitting fuel-generated power to Sydney from an outside source could not be entertained, for economic reasons, until the sites available at Bunnerong, Pyrmont and White Bay had been developed to their ultimate capacities.

Japan.—NEW POWER STATIONS.—It is reported that the Electrical Board of the Japanese Ministry of Communications has approved plans for the construction of six new hydro-electric and ten new steam power stations. The Tokyo Electric Light Co. and another concern are each credited with the intention of starting new works for the manufacture of electrical goods.

Russia.—NEW TRANSMISSION LINE.—The opening took place recently of the largest power system in the Soviet Union, linking up the Dniepr hydro-electric station with the power stations of the Donetz Coal Basin. Electricity generated by the Dniepr River plant was for the first time carried along high-voltage transmission lines to the industrial enterprises of the Donetz Basin. The new transmission line operates at 220 kV and extends for more than 155 miles. During the spring, when the Dniepr River is at a high level, the Dniepr hydro-electric station will send its surplus power to the Donetz Basin. At low water-level periods on the Dniepr the steam-power plants in the Donetz Basin will supply electricity to the regions which cannot be served by the Dniepr station. The combination of water power and steam power will make for the more efficient working of the electric power stations of the Dniepr and the Donetz Basin.

United States.—WATER-POWER STATISTICS.—The Federal Power Commission reports that during 1939 there was an increase of 551,348 HP, or 3.1 per cent., in the total installed capacity of water-power plant in the United States; at the beginning of this year the total capacity was 18,500,254 HP. About 50 per cent. of the increase was attained through the construction of new plants, additions to the capacity of existing installations accounting for the remainder. The States showing the largest increases in installed capacity in 1939 were: Arizona, 232,830 HP; Virginia, 109,807 HP; Alabama, 101,032 HP; Tennessee, 69,158 HP; and Wyoming, 45,039 HP (all figures for plants of 100-horsepower capacity and over). The report reveals that California ranks first in the capacity of its water-power plant, possessing 2,415,859 HP distributed among electrical utilities and 17,410 HP among industrial companies, equal to 13.16 per cent. of the nation's capacity. New York comes second with 1,648,212 HP by all types of electrical utilities and 201,809 HP by industrial companies, constituting 10 per cent. of the country's capacity.—*Reuter's Trade Service.*

TRANSPORT

Hull.—LIGHT AIR-RAID WARNINGS.—A method of indicating air-raid warnings by flickering lights was suggested to the Transport Committee last week by Mr. D. Bellamy, city electrical engineer and acting transport manager. He said that the idea was to have small metal boxes housing 5-W orange lamps clamped to the standards at stopping places. On receipt of a preliminary warning an automatic switch would be operated which would give a flicker on all street connections and would continue during a raid warning. This would assist both drivers and passengers of the Corporation's vehicles. The permission of the Minister of Home Security is to be sought for the installation and use of the system.

London.—NEW TUBE TRAINS.—Underground electric trains began running again last week (October 28th) on the modernised tube line under the River Thames between Waterloo and the Bank. New stock, consisting of 28 coaches made up into five-coach trains, each with a peak capacity of 600 passengers, was put into service.

Southend-on-Sea.—PROPOSED ABANDONMENT OF TRAMWAYS.—At a recent meeting of the Town Council the Transport Committee reported that consideration had been given to a proposal of the general manager that, with a view to avoiding the heavy expenditure which the borough engineer estimated would have to be incurred in the next two years on repairing the tramway track the tramways should be abandoned as soon as possible and a service of trolley-buses and motor-buses operated on the tram routes. Consideration of the matter was adjourned to a special meeting, and instructions were given for inquiries to be made as to the possibility of obtaining the approval of the Ministry of Transport to the execution of the work and consent to the raising of a loan to cover the expenditure.

Sweden. — EMPLOYMENT OF TROLLEY-BUSES.—As a means of economy in petrol the city transport authority at Göteborg has recently started to use trolley-buses. Two routes are also to be opened shortly in Stockholm.

United States.—NEW SHUNTING LOCOMOTIVE.—The General Electric Co. of America announces a new Diesel-electric locomotive designed for shunting and light service which will operate at less than half the cost of a comparable steam locomotive. It is of all-welded construction, weighs 44 tons and has a 380 HP rating. According to the company's engineers, the tractive effort at starting and low speed is greater than that of a steam engine with equivalent weight on the drivers. At the maximum speed of 35 miles an hour the locomotive can haul 224 tons on the level or 67 tons up a one-per-cent. gradient. At 5 MPH it can haul 2,040 tons on the level or 607 tons up a one-per-cent. gradient. As a shunter, the engine operates at a cost of $1.50 an hour against $3.28 for steam, and in road service at $2.18 an hour compared with $5.03. It is reported that several railways have already placed orders for at least a dozen of these new locomotives. —*Reuter's Trade Service.*

Argentine Electrical Imports

Decrease recorded for 1939

THE mission headed by Lord Willingdon which is visiting Argentina with the object of fostering trade and cultural relations between the United Kingdom and Latin America lends special interest to the Argentine foreign trade statistics recently issued in Buenos Aires. They relate to the year 1939 when there was a decline of about 15 per cent. in the value of electrical imports into the Republic.

The accompanying table shows the value of the principal items and gives a note of the increase or decrease as compared with the preceding year. Particulars of the countries of supply are not yet available, but there is no reason to suppose that they differed greatly from those in 1938. Then the United States led in the electrical trade generally with Germany second and the United Kingdom rather far behind both countries in most lines but holding the foremost place in the cable business.

In the radio section Holland outstripped the Reich and in the telephone and cable trade Belgium was fairly well represented. Canada, too, was a runner-up in the telephone branch. Switzerland, Sweden and Austria competed with Germany in the meter business and Japan furnished over half of Argentina's lamp requirements in both 1937 and 1938. The values given in the table are those adopted by the Argentine Customs authorities. (About 17 paper pesos equal £1.)

	1939 Pesos (000)	Inc. or dec. on 1938 Pesos (000)
Dynamos over ¼ HP	2,268	− 1,109
Motors up to ¼ HP	208	− 95
Other dynamos	3	+ 3
Fan motors	341	+ 41
Cable and wire, up to 5 mm., covered with cotton, rubber, etc.	1,678	− 487
Cable and wire over 5 mm., covered with cotton, rubber, etc.	466	− 150
Cable and wire up to 5 mm., lead-covered	407	− 1
Cable and wire over 5 mm., lead-covered	2,944	+ 521
Cable and wire, silk-covered	19	− 24
Cable and wire, enamelled	352	− 24
Flex, covered with cotton, wool, etc.	649	− 552
Flex, covered with silk	46	+ 6
Telephone cables, underground, lead-covered and steel or iron armoured	7,883	− 544
Telephone cables, iron or steel, covered with cotton, gutta-percha, etc.	357	− 27
Accessories for underground cables	60	− 77
Insulators, glass	13	− 19
Insulators, porcelain, etc., over 3 cm. diam.	153	− 72
Insulators, porcelain, etc., up to 3 cm. diam.	54	+ 5
Complete accumulators for motor cars	120	− 28
Other accumulators	2	− 34
Batteries	368	− 896
Parts for accumulators and batteries	1,280	− 56
Jars for ditto	306	− 142
Ammeters and voltmeters	98	− 65
Radio-telephone apparatus	571	− 356
Receiving sets	2,966	− 202
Loud-speakers, metal	455	− 274
Radio-telephone parts	2,940	− 242
Amplifiers	307	+ 142
Radio-telegraph material	26	+ 17
Telephones without coils	37	− 29
Telephones, with coils	751	+ 62
Telephones, magneto	98	+ 1
Telephone material	475	− 453
Telegraph material	67	+ 7
Cookers, toasters, heaters, etc.	125	− 82
Switches, circuit-breakers, cut-outs, fuses, etc.	952	− 546
Vacuum cleaners	139	− 130
Electric bells	82	− 49
Insulating tape	136	− 39
Change-over switches	1,003	− 333
Telephone switchboards	24	− 9
Electric furnaces	84	− 41
Incandescent lamps	1,115	− 664
House-service meters	2,896	+ 1,496
Electric irons	73	− 60
Distribution boards	295	+ 41
Insulating tubes	520	− 662
Electrical materials not elsewhere specified	2,974	− 445

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parenthesis. Copies of any specification (1s. each) can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1938

17660. "Signalling apparatus." British Thomson-Houston Co., Ltd., L. J. Davies and H. R. Ruff. June 14th, 1938. (527488).

33835. "Radio amplifiers and the like." I. L. Maguire. November 26th, 1937. (527626.)

37927. "Photo-electric cells, and methods and means for making, sensitising and stabilising the same." Board of Trustees of the University of Illinois. January 5th, 1938. (527353.)

1939

7083. "Axle counting in railway signalling." Standard Telephones & Cables, Ltd., R. M. Barnard, W. F. Glover and A. Brown. March 3rd, 1939. (527426.)

7102. "Manufacture of electric detonators." W. Taylor, M. Jones, and Imperial Chemical Industries, Ltd. March 3rd, 1939. (Cognate application 28578/39.) (527355.)

7341. "Electric fuel pumps." Stewart-Warner Corporation, and J. B. Whitted. March 7th, 1939. (527552.)

7454. "Electrical indicating apparatus." Tecalemit, Ltd., and C. C. S. Le Clair. March 7th, 1939. (527427.)

7578. "Thermionic valve circuit arrangements." J. Hardwick. March 9th, 1939. (527628.)

7752. "Snap-acting electric thermostats." Westinghouse Electric International Co. March 25th, 1938. (527630.)

8205. "Radio direction finders." Marconi's Wireless Telegraph Co., Ltd., C. S. Cockerell and G. P. Parker. March 14th, 1939. (527495.)

8609. "Automatically variable frequency selective electric wave filters." Marconi's Wireless Telegraph Co., Ltd., N. M. Rust, J. D. Brailsford, A. L. Oliver and J. F. Ramsay. March 17th, 1939. (Divided out of 522476). (527496.)

8978. "Electric-discharge apparatus." British Thomson-Houston Co., Ltd. March 22nd, 1938. (527497.)

9579. "High-voltage insulators." C. W. Marshall and J. S. Forrest. March 27th, 1939. (527357.)

10259. "Electron-discharge devices." Marconi's Wireless Telegraph Co. Ltd. and G. B. Banks. April 1st, 1939. (527433.)

10288. Electric switches and operating gear therefor, particularly applicable to the control of two or more electric motors." Brookhirst Switchgear, Ltd., and C. Lanceley. April 3rd, 1939. (527434.)

10521. "Electrical signal storage and transmission equipment." Standard Telephones & Cables, Ltd. (W. Pouliart). April 4th, 1939. (527505.)

10525. "Control devices of an electrical magnitude such as a potential." Standard Telephones & Cables, Ltd. April 15th, 1938. (527436.)

10830. "Electric liquid heaters." O. A. McDowell and J. P. C. Done. April 6th, 1939. (527511.)

10839. "Vacuum cleaners." Electrolux, Ltd. April 8th, 1938. (527371.)

10895. "Motors for operating reciprocating conveyors." R. P. Finlay and Finlay Conveyor Co., Ltd. April 11th, 1939. (527379.)

10896. "Load-stabilising means for modulating systems." Intercontinental Service Corporation. October 14th, 1938. (527380.)

10917. "Current collector for electric vehicles." Ohio Brass Co. January 25th, 1939. (527385.)

10918. "Current collector for electric vehicles." Ohio Brass Co. October 5th, 1938. (527386.)

10984. "Mercury and other conductive liquid switches." A. H. Stevens. (Amalgamated Engineering & Research Corporation). April 11th, 1939. (527399.)

10987. "Furnace for melting, refining and holding metals." Ajax Electric Furnace Corporation. April 12th, 1938. (527400.)

11000. "Synthetic resinous compositions." British Thomson-Houston Co., Ltd. April 12th, 1938. (527407.)

11001. "Polyvinyl resin compositions." British Thomson-Houston Co. Ltd. April 12th, 1938. (527408.)

11002. "Metal alloys." British Thomson-Houston Co., Ltd. April 13th, 1938. (527409.)

11003. "Electrical insulating materials." British Thomson-Houston Co., Ltd. April 13th, 1938. (527410.)

11004. "Apparatus for producing high-voltage impulses." British Thomson-Houston Co., Ltd., and H. de B. Knight. April 11th, 1939. (527411.)

11005. "Methods of producing discharges suitable as ignition sparks." British Thomson-Houston Co., Ltd., and H. de B. Knight. April 11th, 1939. (527412.)

11063. "Automatic telephone systems." Electrical Research Products, Inc. April 13th, 1938. (527441.)

11096. "Mechanical refrigerating apparatus." Murphy Radio. Ltd., and C. R. Walters. April 12th, 1939. (527448.)

11103. "Electro-magnetic interruptors for electrical circuits." British Thomson-Houston Co., Ltd. April 12th, 1938. (527647.)

11104. "Electric rotary switches." British Thomson-Houston Co., Ltd. April 13th, 1938. (527451.)

11207. "Sealing of electric conductors through quartz envelopes." General Electric Co., Ltd., and E. Kettlewell. April 13th, 1939. (Addition to 489630.) (527476.)

11221. "Telephone apparatus." C. A. Reynier. April 13th, 1939. (527480.)

11222. "Automatic control of the speed of electric motors." British Thomson-Houston Co., Ltd., F. J. Everest and L. C. Ludbrook. April 13th, 1939. (527481.)

11223. "Clothes wringers." British Thomson-Houston Co., Ltd. April 13th, 1938. (527482.)

11224/5. "Sealing-in machines for electric lamps and the like." British Thomson-Houston Co., Ltd. April 13th, 1938. (527512/3).

11230. "Permeability-tuned wave trap, and core construction therefor." Johnson Laboratories, Inc. April 14th, 1938. (527514.)

11280. "Art of producing magnetic materials." W. P. Williams. (American Rolling Mill Co.) April 13th, 1939. (527525.)

11286. "Tuning devices for radio apparatus." C. H. Dierks. April 14th, 1939. (527526.)

11353. "Current conversion systems." Westinghouse Electric International Co. April 14th, 1938. (527538.)

11354. "Magnetic shunts for use in watthour meters or other electro-magnetic measuring instruments of the induction type." Westinghouse Electric International Co. April 28th, 1938. (527539.)

11355. "Apparatus for washing fabrics or the like." Westinghouse Electic International Co. April 23rd, 1938. (527540.)

11372. "Cathode-ray tubes, and methods of operating them." General Electric Co., Ltd., and L. C. Jesty. April 14th, 1939. (527547.)

11431. "Electric signal transmission systems." Standard Telephones & Cables, Ltd. April 22nd, 1938. (527564.)

11438. "Electron beam devices." British Thomson-Houston Co., Ltd. April 15th, 1938. (Addition to 518015.) (527567.)

11439. "Electric thermal switches." British Thomson-Houston Co., Ltd. April 14th, 1938. (527568.)

11440. "Shaft packings." British Thomson-Houston Co., Ltd. April 15th, 1938. (527569.)

11441. "Electric insulating materials." British Thomson-Houston Co., Ltd. April 16th, 1938. (527570.)

11498. "Conducting liquid switches." S. Rossi. April 15th, 1939. (527583.)

11534. "Indicating means for measuring and like instruments." L. W. C. Edwards, F. C. Rickards. April 15th, 1939. (527592.)

11582. "Apparatus for receiving television and like signals." General Electric Co., Ltd., W. H. Aldous, and G. W. Edwards. April 17th, 1939. (527602.)

11591. "Electric dental furnaces." Svedia Svensk Dental-Industri A.-B., and B. Feron. April 17th, 1939. (527603.)

11631. "Tuning arrangement for oscillatory circuits." L. de Kramolin. April 30th, 1938. (527649.)

11722. "Modulated carrier-wave signalling systems." Marconi's Wireless Telegraph Co., Ltd. April 19th, 1938. (527668.)

11737. "Mechanism for controlling the direction of rotation of synchronous electric motors." R. Elms. April 18th, 1939. (527673.)

11759. "Electrical supply fittings." R. W. Haggar. May 23rd, 1938. (527676.)

11762. "Telephone systems." A. Graham & Co., Ltd., and E. E. Smith. April 19th, 1939. (527677.)

11790. "Sources of light comprising luminescent materials." General Electric Co., Ltd., J. N. Bowtell, H. G. Jenkins and A. H. McKeag. April 19th, 1939. (527685.)

11799. "Hygrometers." British Thomson-Houston Co., Ltd. April 21st, 1938. (527686.)

11800. "Methods of producing electric resistance." British Thomson-Houston Co., Ltd. April 21st, 1938. (527687.)

11807. "Graduated tariff apparatus, more particularly electrical meters." Landis & Gyr Akt.-Ges. February 20th, 1939. (527688.)

15877. "Apparatus for applying extended surface elements to the tubes of heat-exchange devices." Foster Wheeler, Ltd. December 20th, 1938. (527615.)

15878. "Cooling towers." Foster Wheeler, Ltd. June 29th, 1938. (527616.)

25269. "Electrical apparatus." Philips Lamps, Ltd. September 6th, 1938. (527691.)

1940

4080. "Electric switches mounted in sealed containers." Stewart-Warner Corporation, and J. B. Whitted. March 7th, 1939. (Divided out of 527552.) (527624.)

12614. "Photo-electric cells, and method far making, sensitising and stabilising the same." Board of Trustees of the University of Illinois." January 5th, 1938. (Divided out of 527353.) (527484.)

FINANCIAL SECTION

New Companies. Capital Returns. Debenture Charges. Bankruptcies and Liquidations. Reports and Dividends. Stocks and Shares

Company Registrations

Robert Campbell, Ltd.—Private company. Registered in Edinburgh October 22nd. Capital, £1,200. Objects: To acquire the business of a radio and electrical dealer carried on by Robert Campbell at 5, Ranfurly Terrace, Bridge of Weir. Directors: R. B. W. Campbell, "Cahirmore," Brookfield, Renfrewshire, and two others. Registered office: 5, Ranfurly Terrace, Bridge of Weir, Renfrewshire.

Kenton Engineering Co., Ltd.—Private company. Registered October 26th. Capital, £1,000. Objects: To carry on the business of manufacturers of and dealers in machinery, engineering equipment, tools, gauges, instruments, electrical equipment and apparatus, motive plant, etc. Subscribers: A. Clarke, Chequers, Mountsorrel Lane, Rothley, and Wm. G. Hackett, "Kennington," Halstead Road, Mountsorrel. Solicitors: Ironside and Company, 5, Bowling Green Street, Leicester.

Allan Eyre & Co., Ltd.—Private company. Registered October 3rd. Capital £3,000. Objects: To acquire the business of an electrical and colliery stores distributor now carried on by F. A. Eyre at 191, Chatsworth Road, Chesterfield, Derby, as "Allan Eyre & Co." Directors:—F. A. Eyre (permanent director and chairman), Walton Ridge, Walton, nr. Chesterfield, and C. I. Sanderson, 80, Holymoor Road, Holymoorside, nr. Chesterfield. Secretary, F. A. Eyre.

Companies' Returns

Statements of Capital

Geo. Bray & Co., Ltd.—Capital, £160,000 in 80,000 preference and 80,000 ordinary shares of £1. Return dated August 6th. 55,000 preference and 55,000 ordinary shares taken up. £7 paid. £109,993 considered as paid. Mortgages and charges, £40,000.

Raydex Electric Heaters, Ltd.—Capital, £2,000 in £1 shares. Return dated August 1st. Two shares taken up. £2 paid. Mortgages and charges, nil.

Express Battery Co., Ltd.—Capital, £600 in £1 shares. Return dated July 1st. All shares taken up. £600 paid. Mortgages and charges, nil.

Automotive Electrical Engineers, Ltd.—Capital, £500 in £1 shares. Return dated July 1st. 300 shares taken up. £300 paid. Mortgages and charges, nil.

Harry Astbury, Ltd.—Capital, £1,000 in £1 shares. Return dated April 26th. 366 shares taken up. £366 paid. Mortgages and charges, nil.

Fullick & Loosley, Ltd.—Capital, £1,000 in 600 preference and 400 ordinary shares of £1. Return dated May 9th. 80 preference and 400 ordinary shares taken up. £370 paid. £110 considered as paid. Mortgages and charges, £1,250.

Bournemouth & Poole Electricity Supply Co., Ltd.—Capital, £1,300,000 in 75,000 4½ per cent. cumulative preference, 325,000 6 per cent. cumulative preference and 154,231 ordinary shares of £1, and £745,769 ordinary stock. Return dated April 11th. 75,000 4½ per cent. preference and 190,250 6 per cent. preference shares and £745,769 ordinary stock taken up. £550,000 paid on 75,000 4½ per cent. preference and 175,000 6 per cent. preference shares and £300,000 ordinary stock. £461,019 considered as paid on 15,250 6 per cent. preference shares and £445,769 ordinary stock. Mortgages and charges, £400,000.

Barlborough Electric Supply Co., Ltd.—Capital, £3,000 in £1 shares. Return dated May 23rd. 2,967 shares taken up. £2,967 paid. Mortgages and charges, nil.

Unity Heating, Ltd.—Capital, £30,000 in £1 shares. Return dated June 22nd. All shares taken up. £30,000 paid. Mortgages and charges, £5,046 4s. 10d.

Morley Electrical Engineering Co., Ltd.—Capital, £5,000 in £1 shares. Return dated June 24th. All shares taken up. £3,980 paid. £1,020 considered as paid. Mortgages and charges, £1,000.

United Telephone Cables, Ltd.—Capital, £1,000 in £1 shares. Return dated June 27th. All shares taken up. £1,000 paid. Mortgages and charges, nil.

New Era Electrical Manufacturers, Ltd.—Capital, £100,000 in 50,000 preference and 50,000 ordinary shares of £1. Return dated June 28th. 1,504 ordinary shares taken up. £1,504 paid. Mortgages and charges, nil.

A. Berkeley, Ltd.—Capital, £10,000 in £1 shares. Return dated May 9th. 7,800 shares taken up. £7,800 paid. Mortgages and charges, nil.

Crypton Equipment, Ltd.—Capital, £1,000 in £1 shares. Return dated April 15th. All shares taken up. £1,000 paid. Mortgages and charges, £41,000.

Amesbury Electric Light & General Supply Co., Ltd.—Capital, £12,000 in £1 shares. Return dated March 21st (filed April 22nd). All shares taken up. £12,000 paid. Mortgages and charges, nil.

L. E. Wilson & Co., Ltd.—Capital, £2,000 in £1 shares. Return dated May 20th. 1,602 shares taken up. £1,602 paid. Mortgages and charges, nil.

Peacock & Waller, Ltd.—Capital, £2,000 in £1 shares. Return dated April 2nd. 1,800 shares taken up. £1,800 paid. Mortgages and charges, nil.

T. G. Brunskill, Ltd.—Capital, £1,000 in £1 shares. Return dated March 1st. 701 shares taken up. £701 paid. Mortgages and charges, £250.

Austinlite, Ltd.—Capital £6,000 in £1 shares. Return dated June 28th, 1940. All shares taken up. £6,000 paid. Mortgages and charges: Nil.

Frank Wall & Co., Ltd.—Capital £1,000 in £1 shares. Return dated June 5th, 1940. All shares taken up. £1,000 paid. Mortgages and charges: Nil.

Bideford & District Electric Supply Co., Ltd.—Capital, £160,000 in £1 shares. Return dated June 5th. All shares taken up. £148,400 paid. £11,600 considered as paid. Mortgages and charges, nil.

Milnes Distributors (South Eastern), Ltd.—Capital, £500 in £1 shares. Return dated June 11th. All shares taken up. £500 paid. Mortgages and charges, nil.

Southern United Telephone Cables, Ltd.—Capital, £75,000 in £1 shares. Return dated June 27th. All shares taken up. £75,000 paid. Mortgages and charges, nil.

Culm Valley Electric Supply Co., Ltd.—Capital, £80,000 in £1 shares. Return dated June 21st. 75,000 shares taken up. £69,410 paid. £5,590 considered as paid. Mortgages and charges, nil.

Colombo Electric Tramways & Lighting Co., Ltd.—Capital, £150,000 in £10 shares. Return dated June 25th. 13,084 shares taken up. £840 paid. £130,000 considered as paid. Mortgages and charges, nil.

Mortgages and Charges

Lawson Beck, Ltd.—Satisfaction in full on October 10th, 1940, of debenture dated December 17th, 1938, and registered same date securing £200.

Receiver Released

Bowlings Electric Supply, Ltd.—E. J. C. Swaysland, of 45a, High Street, Croydon, ceased to act as receiver and manager on October 5th, 1940.

Bankruptcies

K. Bader, electrical equipment manufacturer, lately carrying on business at Westmoreland Road, Hendon.—Receiving order made October 11th on a creditor's petition.

C. F. A. Henckel (Dawson & Henckel) electrical dealer, 42, Gray's Inn Road, London, W.C.1.—Receiving order made October 14th on debtor's own petition. Public examination November 28th at Bankruptcy Buildings, Carey Street, W.C.2.

E. A. Kann, electrical and radio manufacturers' agent, 61, Lansdowne Place, Hove.—Public examination November 15th at the Court House, Brighton.

A. T. Burden ("Meth-Lac" Works), electrical engineer, Upper Devizes Road, Salisbury.—Supplemental dividend of 11s. in the £, payable October 25th at 12, Rolleston Street, Salisbury.

J. H. Matthews, electrical dealer, 232, Town Street, Bramley, near Leeds.—Public examination November 19th, at the County Court, Leeds.

H. A. Smith, electrical engineer and contractor, 76, Canterbury Street, Gillingham.—Last day for receiving proofs for dividend, November 11th. Trustee, Mr. F. C. Wells, 280a, High Street, Rochester, Official Receiver.

J. Stubbs and **J. A. P. Boulton** (John Stubbs & Co.), electrical engineers, 39, Bootham, York. (Separate application of J. A. P. Boulton).—Discharge suspended for six months until March 24th, 1941.

Reports and Dividends

The Perak River Hydro-Electric Power Co. reports revenue for the year ended July 31st, after writing down plant on consumers' premises and bad debts, of £600,952, as compared with £246,454 for 1938-39, and after deducting Malayan expenses for generation, distribution and management there is a profit of £329,366 (against £162,353). From this are deducted London expenses and directors' fees, leaving a net revenue of £320,184 (£153,869). Debenture interest requires £43,210, sinking fund £54,285 and preference dividend £38,281. Provisions of £100,000 and £8,000

(*Continued at foot of page* 25)

STOCKS AND SHARES

Tuesday Evening.

STEADINESS of prices is the outstanding feature of Stock Exchange markets. Notwithstanding the stream of money which flows into National War Bonds and other forms of national borrowing, a good deal of cash is available for investment in good-class industrial stocks and shares of which, as so frequently mentioned, there is but a scanty supply. The Government has made a vesting Order for the taking over of sixty Canadian stocks and shares, the earliest payments in respect of which will be made on November 26th. Reinvestment of this money is taking place in advance. Under the Government scheme, the money thus realised can be diverted straightway into one or other of the national loans now on offer. Some of the holders of the stocks, arguing that the interest can hardly be described as a living rate, require alternative investments that will give a better return, and, on this account, purchases are being made of stocks and shares in many industrial companies, the stability of which is regarded as virtually gilt-edged. The news from the Near East has had no effect in checking the demand for sound securities.

Canadian Utility Bonds

As just mentioned, the stocks and bonds held by British residents in sixty different Canadian undertakings are now requisitioned by the Treasury under the vesting Order which requires holders to register their securities with the Bank of England. This latest Order, the third in its series, says that this registration shall be effected at once. The two previous Orders applied mainly to United States stocks and shares. The present requisition is the first to affect Canadian industrial and railway stocks. Amongst them are a number of bonds in light, heat and power companies domiciled in Canada. A fair amount of the stock is held on this side. Holders are to be paid out at once at fixed prices.

The prices to be paid by the Treasury for these holdings are those current in Canada at the time that the Order was made, and to these prices is added the amount of accrued interest due on each bond. Holders resident in this country are given no option of retaining the bonds; these are being acquired compulsorily under the Order.

Electricity Supply Shares

No marked change has occurred in the prices of electricity supply stocks and shares, but the tone of the market is extremely firm, and the dealers themselves admit surprise at the steady manner in which absorption of the issues goes on. Reference to the final column of the list of Home Electricity Supply shares will show that the yield on the good-class shares ranges from 5 to 7 per cent. If it be contended that an average of 6 per cent. offers no great attraction at a time like this, the reply is simply that the demand persists, and that whenever shares do come to market they can count upon being readily taken.

The County of London ordinary have lost the $\frac{1}{16}$ gain of last week. A reduction in the previously paid 10½ per cent. dividend is regarded as being fairly certain. City "Lights" are better at 20s. 9d. Midland Counties and Yorkshire Electrics hardened to 28s. 9d. and 30s. respectively.

Thomas Tilling

Thomas Tilling ordinary shares have hardened to 40s., a price which, on the dividend record of the company, would seem to be sufficiently high. For five years past, Thomas Tilling has distributed 10 per cent. annually, and the interim dividend, paid on September 14th last, of 5 per cent., will be supplemented, it is assumed, by a further 5 per cent. final dividend five months hence. At 40s. the yield would be, therefore, 5 per cent. on the money, a rate which does not look particularly generous at a time when income tax is 8s. 6d. in the £ and when other industrial investments of high standing give a better yield. It has not escaped notice, however, that most of the provincial omnibus undertakings in which Thomas Tilling is interested are doing extremely well, as their dividend announcements witness.

Dividend and Earnings

The appearance in the London streets of provincial omnibuses serves indirectly to turn attention to the Thomas Tilling shares. One of the principal interests of the company is in Tilling & British Automobile Traction, in which it holds nearly two million of the £1 ordinary shares. Besides these, Thomas Tilling owns practically £4½ million in London Passenger Transport stocks, of which over £1 million is in the "C" stock. Tilling's earnings have increased annually since 1934, the figure in that year being £319,605, comparing with £551,000 for 1939. Although anticipation looks for no increase in the current year's dividend, it is clear that after the war, the present year's results are likely to place Thomas Tilling in a stronger position than ever. The present purchasers consider that the shares take rank as a first-class industrial investment with good post-war prospects.

Anglo-Argentine Trams

Anglo-Argentine Tramways debenture stocks have been rising sharply upon the development of an interesting situation in Buenos Aires. The company's 4 per cent. income debenture stock, which was standing a week or two ago at 2½, is now about 7. The company, it may be recalled, is a holding concern, having sold its undertaking to the Buenos Aires Transport Board in exchange for stock of that body, which controls practically all the transport in the City of Buenos Aires, with the exception of certain privately-run cars. These latter, called "collectivos"—*anglicé*, microbuses—although they are small, afford rapid transport at cheap rates. The owners have hitherto refused to enter the Buenos Aires Transport Board, because the purchase money of the undertakings would have to be satisfied in the Board's stock; the owners have stood out for cash. Judging by hints in the Buenos Aires newspapers, it would appear as though agreement between the owners of these collectivos and the Transport Board may be nearing completion. If this is satisfactorily settled, the principal source of competition will be removed and the Anglo-Argentine Tramways issues will come into greater prominence. Holders of the stocks now await with interest further developments.

Boards—Present and To Come

The operation of the Home Railways under a Government guarantee of earnings has given rise to the proposal that, when this country has won the war, consideration might be profitably turned to a scheme for amalgamating the companies under a single board or authority. In other words, the railways, instead of being run as individual concerns, might come under the control of one huge board which would treat the country's railway industry as a single entity. This would be, of course, none other than our old friend nationalisation, regarded now, however, in a light very different from that when its mere mention was as an unshaded light is to-day to an A.R.P. patrol. That developments of this nature are likely to appear after the war, is more than likely. One of them, it may be predicted, will be the examination of proposals for linking up the electricity supply industry into one vast system. In the Home Railway world, a start was made some time ago by the creation of the London Passenger Transport Board. The Central Electricity Board and the Cable and Wireless combine are two obvious examples of a trend which post-war conditions cannot fail to emphasise.

Anglo-Portuguese Telephone

Speculation is discussing the prospects of the Anglo-Portuguese Telephone Company, in view of the fall that has taken place in the price of the shares. The company is a sound concern, and has been doing well for years past. Its shares would not be standing where they are to-day except for the fact of the locality of the property. For investment that cares to take the political risk involved in a purchase of Anglo-Portuguese Telephones, the yield of 10¾ per cent. on the shares warrants consideration.

Miscellaneous Matters

British Electric Traction deferred stock has risen 50 points to 725. It is difficult to obtain an offer of stock under 10 or 15 points higher than this. The same reasons which have brought about the rise in Tilling shares are operative in the case of British Electric Traction deferred. The company's 8 per cent. preferred ordinary stock is unchanged at 140. Calcutta Trams have risen a florin to 19s. on maintenance of the interim dividend, and the market is steady as a whole. Amongst the equipment and manufacturing shares, Johnson & Phillips stand out with a rise of 2s. 6d. to 42s. 6d. Hopkinsons advanced similarly to 36s. 3d. General Electrics are better at 72s. 6d. English Electrics have risen to 27s. 6d. and Ever Readys to 25s. 6d. Crabtree 10s. shares at 20s. are ex the dividend which made 17½ per cent. for the year. Cable and Wireless stocks have come on offer. On the other hand, demand continued for Anglo-American Telegraph issues. The company's 6 per cent. preferred has risen to 94 and the deferred stock to 22½. Marconi Marines have improved to their par price of 20s.

ELECTRICAL COMPANIES' SHARES

Prices, Dividends and Yields

Company	1940 Highest	1940 Lowest	Dividend Previous	Dividend Last	Middle Price Nov. 4	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies							
Bournemouth and Poole ..	63/6	37/6	15	15	38/9	..	—
British Power and Light ..	30/–	21/–	7	7	23/6	..	5 19 2
City of London	28/–	20/–	7½	7½	20/9	+9d.	—
Clyde Valley	38/6	25/–	8	8	31/3	..	5 2 5
County of London ..	43/3	22/–	10½	10½	26/3	−½	8 0 0
Edmundson's:							
7% Pref...	31/6	26/3	7	7	28/3	..	4 19 1
Ord.	27/6	18/6	9	6	22/–	..	5 9 1
Elec. Dis. Yorkshire ..	40/3	32/6	9	9	32/6	..	5 10 9
Elec. Fin. and Securities ..	41/3	34/6	12½	12½	38/9	..	6 9 0
Elec. Supply Corporation..	46/3	37/–	12	11½	37/–	..	6 4 4
Isle of Thanet	16/–	5/6	4	4	6/–	..	—
Lancs Light and Power ..	33/–	25/–	7½	7½	25/–	..	5 16 6
Llanelly Elec.	21/–	17/–	5½	5½	17/6	..	6 5 9
Lond. Assoc. Electric ..	21/–	12/6	7	5½	13/3	..	—
London Electric	37/6	19/–	8	7	20/–	..	7 0 0
London Power Deb. Red...	105½	101	5	5	100½	..	4 19 6
Metropolitan	41/6	23/6	12	10	27/6	..	7 5 6
Midland Counties	39/–	24/3	8	8	28/9	+¼	5 11 5
Mid. Elec. Power	40/–	29/6	9	9	32/–	..	5 12 6
Newcastle Elec.	29/9	22/6	7	7	22/6	..	6 7 3
North Eastern Elec.:							
Ordinary..	31/6	17/6	7	7	22/6	..	6 4 5
7% Pref...	32/6	26/6	7	7	27/6	..	5 1 10
Northampton	48/–	39/–	10	10	38/9	..	5 3 3
Notting Hill 6% Pref. (£10)	10⅜	9	6	6	9	..	—
Northmet Power:							
Ordinary..	42/3	23/–	10	10	27/6	−9d.	—
6% Pref...	29/–	23/–	6	6	26/–	..	4 12 4
Richmond Elec.	24/6	18/–	7	6	18/9	..	—
Scottish Power	38/–	24/–	8	8	28/9	..	5 11 5
Southern Areas	21/3	13/9	5	5	13/3	+¼	7 11 0
South London	23/3	20/–	7	7	20/–	..	7 0 0
West Devon	20/–	18/6	5	5	20/–	..	5 0 0
West Glos.	21/3	15/–	2½	4½	16/3	..	5 10 10
Yorkshire Elec.	40/–	24/6	8	8	30/–	+6d.	5 6 8
Overseas Electricity Companies							
Atlas Elec.	4/–	1/3	Nil	Nil	1/9	..	—
Calcutta Elec.	37/–	22/6	10*	8*	30/–	..	5 6 8
Cawnpore Elec.	30/–	24/–	10	10	25/–	..	8 0 0
East African Power ..	25/6	20/–	7	7	20/–	..	7 0 0
Jerusalem Elec.	24/–	17/9	7	7	16/3	..	8 12 4
Kalgoorlie (10/–)	12/6	9/6	7½	7½	11/–	..	6 16 5
Madras	26/9	23/6	8*	6*	25/–	..	4 16 1
Montreal Power	35½	30	1½	1½	32	..	—
Palestine Elec. "A" ..	25/–	9/–	5*	Nil	11/3	−¼	—
Perak Hydro-electric ..	20/3	13/6	2½	6	15/–	..	8 0 0
Shawinigan Power ..	27½	19	83cts.	90cts.	20	..	—
Tokyo Elec. 6%	69	52	6	6	30	..	20 0 0
Victoria Falls Power ..	75/9	56/6	15	15	65/–	..	4 12 4
Whitehall Investments Pref.	17/9	8/–	7½	7½	10/–	..	15 0 0
Public Boards							
Central Electricity:							
1950–70	110½	104	5	5	105½	..	4 14 8
1955–75	112½	106	5	5	107½	..	4 13 0
1951–73	107½	102	4½	4½	103½	..	4 7 0
1963–93	96½	90	3½	3½	90½xd.	..	3 17 6
London Elec. Trans. Ltd...	92	87½	2½	2½	93	..	2 13 9
London & Home Counties							
1955–75	113½	105	4½	4½	105½	..	4 5 4
Lond. Passenger Transport:							
A	116	104	4½	4½	106	..	4 5 0
B	116	102½	5	5	104½	..	4 15 8
C	65½	25	1½	1½	27	..	5 11 2
West Midland Joint Elec.							
1948–68	106½	103	5	5	105½	..	4 14 9
Telegraph and Telephone							
American Tel. & Tel. ..	215	180	9	9	200	..	4 10 0
Anglo-Am. Tel.:							
Pref.	106	85	6	6	94	+1½	6 7 8
Def.	23½	18	1½	1½	22½	+1	6 13 4
Anglo-Portuguese	22/6	10/–	8	8	15/–	..	10 13 4
Cable & Wireless:							
5½% Pref.	99½	70	4½	5½	84	−1	6 11 0
Ord.	65	28½	4	4	49	−1½	8 3 4
Income	99½	93	..	..	98½	+1½	4 0 0
Canadian Marconi $1 ..	6/–	4/–	Nil	4cts.	4/6	..	—
Globe Tel. & Tel.:							
Ord.	32/6	21/6	7½*	6*	25/–	..	4 16 0
Pref.	27/9	22/6	6	6	23/9	..	5 1 1
Great Northern Tel. (£10)..	20	11	20	20	12½	..	—
Inter. Tel. & Tel.	5½	3	Nil	Nil	3½	..	—
Marconi-Marine	30/–	18/3	10	7½	20/9	+¼	7 10 0
Oriental Telephone Ord. ..	2⅝	47/6	12*	11½*	2⅞	..	4 16 10
Telephone Props.	15/–	11/–	5	6	12/6	..	9 12 0
Telephone Rentals (5/–) ..	9/6	5/9	10	10	6/3	..	8 0 0

Company	1940 Highest	1940 Lowest	Dividend Previous	Dividend Last	Middle Price Nov. 4	Rise or Fall	Yield p.c. £ s. d.
Traction and Transport							
Anglo. Arg. Trams:							
First Pref. (£5)	4/3	1/3	Nil	Nil	2/–	..	—
4% Inc.	11½	2	Nil	Nil	7	..	—
British Electric Traction:							
Def. Ord.	830	440	5	45	725	+50	6 4 4
Pref. Ord.	169	134	8	8	140	..	5 14 3
Bristol Trams	48/6	34/6	10	8*	35/–	..	—
Brazil Traction	12½	5½	$1	50c.	5½*	..	—
Calcutta Trams	24/–	16/3	8	5½	19/–	+2/–	5 15 9
Cape Elec. Trams ..	18/6	16/–	5	5	17/–	..	5 17 8
Lancs Transport	35/–	27/6	10	10	30/–	..	6 13 4
Mexican Light:							
1st Bonds	36	27	5	5	35	..	—
Rio 5% Bonds	95	74	5	5	90	..	5 11 3
Southern Rly.:							
5% Prefd.	79	35	5	5	43½	−1	11 10 0
5% Pref...	104½	60	5	5	74½	..	6 14 3
T. Tilling	45/9	31/–	10	10	40/–	+¼	5 0 0
Tilling & B.A.	47/6	41/9	9*	8*	40/9	−¼	—
West Riding	35/–	26/–	10	10	31/–	..	6 9 0
Equipment and Manufacturing							
Aron Electricity Ord. ..	17/6	10/–	15	Nil	14/–	..	—
Assoc. Elec.:							
Ord.	43/3	27/–	10	10	36/3	..	5 10 4
Pref.	35/3	32/3	8	8	35/–	..	4 11 5
Automatic Telephone & El.	47/3	32/–	12½	12½	37/6	..	6 13 4
Babcock & Wilcox ..	50/–	28/6	10	11	35/9	+9d.	6 2 9
British Aluminium Ord. ..	56/–	33/–	12½	12½	38/9	−9d.	—
British Insulated Ord. ..	92/6	67/–	20	20	77/6	..	5 6 8
British Thermostat (5/–) ..	14/9	6/6	18½	18½	9/6	..	9 14 8
British Vacuum Cleaner (5/–)	12/6	4/9	40	12½	6/3	..	10 0 0
Brush Ord.	4/6	1/9	Nil	Nil	2/6	..	—
Callender's	69/–	46/–	15	15	56/3	..	5 6 9
Chloride Elec. Storage ..	72/6	55/–	15	15	2⅝	..	5 4 4
Consolidated Signal ..	72/6	59/–	36½	17	60/–	..	5 13 4
Crabtree (10/–)	24/9	17/6	17½	17½	20/–xd.	..	8 15 0
Crompton Parkinson:							
Ord. (5/–)	20/–	12/6	30	20	15/–	..	6 13 4
E. K. Cole (5/–)	5/–	2/6	10	Nil	4/–	+6d.	—
Elec. & Musical Industries							
(10/–)	10/3	4/3	5	Nil	8/–	..	—
Electric Construction ..	36/3	27/6	13½	10	27/6	..	7 5 6
Enfield Cable Ord. ..	56/–	40/6	25	16½	45/–	..	7 5 5
Electrical Switchgear (10/–)	22/6	20/–	16	10	20/–	..	5 0 0
English Electric	33/9	16/6	10	10	27/6	+¼	7 5 4
Ensign Lamps (5/–) ..	15/3	12/6	25	25	13/9	..	9 1 10
Ericsson Tel. (5/–) ..	39/3	25/–	25*	25*	25/–	..	—
Ever Ready (5/–)	28/3	17/3	30	40	25/6	+6d.	7 16 10
Falk Stadelmann	18/3	12/6	6	7	13/9	..	10 3 8
Ferranti Pref.	25/–	23/–	7	7	23/9	..	5 18 0
G.E.C.:							
Pref.	32/6	27/–	6½	6½	28/9	..	4 10 6
Ord.	83/3	56/–	20	20	72/6	+¼	5 10 1
Greenwood & Batley ..	25/6	20/–	15	13	20/–	..	13 0 0
Hall Telephone (10/–) ..	18/6	8/9	15	10	11/3	..	8 17 10
Henley's (5/–)	21/6	13/6	20	20	17/6	..	5 14 3
4½% Pref.	21/3	20/6	4½	4½	21/3	..	4 4 8
Hopkinsons	46/9	33/6	12½	15	36/3	+½	8 5 6
India-Rubber Pref. ..	21/–	19/6	5½	5½	20/–	..	5 10 0
Intl. Combustion	121/3	70/–	32½	32½	3⅜	..	8 13 4
J. Lucas	60/6	40/–	15	15	48/9	+¼	6 3 0
Johnson & Phillips ..	50/9	33/–	12½	15	42/6	+½	7 1 2
Lancashire Dynamo ..	59/9	47/6	25	20	47/6	..	8 8 5
Laurence Scott (5/–) ..	11/–	6/–	15	15	7/–	..	9 7 6
London Elec. Wire ..	25/6	20/–	7½	7½	22/6	..	6 13 4
Mather & Platt	46/6	30/–	13½	10	33/9	..	5 18 6
Metropolitan Elec. Cable Pf.	22/–	21/3	5½	5½	21/3	..	5 3 6
Murex	86/9	52/6	20	20	72/6	..	5 10 4
Pye Deferred (5/–) ..	9/–	6/9	25	25	8/9	..	14 5 8
Revo (10/–)	20/9	11/6	17½	5	17/6	..	2 17 6
Reyrolle	60/6	41/–	12½	12½	45/–	..	5 11 2
Siemens Ord.	23/9	16/3	7½	7½	16/3	..	9 4 8
Strand Elec. (5/–) ..	2/3	9d.	10	4	1/3	..	16 0 0
S. Smith (1/–)	8/–	3/6	37½	50	7/6	..	6 13 4
Switchgear & Cowans (5/–)	11/9	5/6	20	10	7/–	..	7 2 10
Telegraph Condenser (10/–)	8/9	6/3	5	..	7/6	..	—
Telegraph Construction ..	42/6	29/–	10	10	31/3	..	6 8 0
Telephone Mfg. (5/–) ..	9/–	5/–	9	9	6/–	+3d.	7 10 0
Tube Investments.. ..	96/9	61/3	23¾	23¾	83/9	+¼	5 14 0
Vactric (5/–)	3/6	2/–	4	Nil	2/3	..	—
Vickers (10/–)	22/–	9/6	10	10	13/6	−6d.	7 8 2
Ward & Goldstone (5/–) ..	19/9	12/6	20	20	12/6	..	8 0 0
Westinghouse Brake ..	46/–	32/6	17½	10	32/6	..	6 3 1
Walsall Conduits (4/–) ..	26/6	17/6	55	55	23/9	..	9 5 0
West, Allen (5/–)	7/–	3/–	10	7½	3/9	..	10 0 0

* Dividends are paid free of Income Tax.

CONTRACT INFORMATION

Particulars of work for which tenders are invited, contracts placed, and building schemes promising work for electrical contractors and traders

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parenthesis. Further details of items marked with an asterisk can be obtained from the Department of Overseas Trade (Inquiry Room), Great George Street, London, S.W.1.

Birkenhead.—November 18. Electricity Department. E.h.v. cable, l.v. cable (paper insulated), l.v. cable (rubber insulated), meters & general stores for six months from January 1st, 1941. (See this issue.)

Brighouse.—November 11th. Borough Council. Electrical work in connection with extensions to the fire station. Forms of tender from the borough engineer, Commercial Street. (Deposit: £1 1s.) Tenders to E. H. Clegg, Town Clerk, Town Hall.

Chester-le-Street.—Installation of electric lighting in air-raid shelters at Great Lumley; surveyor, Rural District Council Offices.

Durham.—Installation of electric lighting in air-raid shelters at Houghton-le-Spring; county surveyor, Shire Hall, Durham.

Ebbw Vale.—November 29th. Electricity Department. H.v. and pilot cables, substation switchgear and transformers. (See this issue.)

Eire.—WEXFORD.—November 11th. Wexford Board of Health & Public Assistance. Electrically heated and driven laundry equipment at the Board's building at Grianan Charmainm, Enniscorthy, and preparation of site, wiring, &c. Drawings, specification, &c., from the engineer (deposit £5 5s.) Tenders to T. D. O'Sionoid, secretary, County Hall, Wexford.

New Zealand. — WELLINGTON. — Public Works Department. November 26th. 40-ton three-motor electric overhead travelling crane. (T.22012/40.)*

January 14th. Two 3,000-kVA, 11-kV, three-phase, 50-cycle outdoor-type voltage regulating transformers and control equipment. (T.22238/40.)*

Newport (I.O.W.)—Booster plant for Cowes water supply; borough engineer, Quay Street, Newport.

South Africa.—PRETORIA.—Union Tender & Supplies Board. December 12th. Electric light fittings for G.P.O. (T.22426/40.)*

November 20th. City Council. Low-voltage industrial-type switchboard. (T. 22052/40.)*

December 4th. Laundry equipment. (T. 21987/40.)*

January 4th. Plant at gasworks, Cottesloe: (a) One 200-kW rotary convertor and associated equipment. Alternatively (b) one 200-kW mercury arc rectifier or (c) two 100-kW mercury arc rectifiers. (d) Equipment for spare power circuit frame. (T. 22424/40.)*

DURBAN.—November 29th. Electricity Department. Eleven 6,600 V switch panels. (T.22622/40.)*

Wolverhampton.—December 3rd. West Midlands Joint Electricity Authority. High- and low-voltage AC cables and low-voltage DC cables. (See this issue.)

Orders Placed

Birmingham.—In our October 25th issue we stated that the Salvage Committee had accepted the tender of the Young Accumulator Co., Ltd., for a supply of electric batteries for one year. We are informed, however, that this is a part-contract only.

Bootle.—Works Committee. Accepted. Cable and flexible cord.—Liverpool Cable Co. (extension of contract).

Cardiff.—Electricity Committee Accepted. Supervisory control equipment for the pumping scheme (£1,319)—Standard Telephones & Cables, Ltd. Sub-station switchgear (£139)—Whitehead Switchgear & Inventions, Ltd. 33 kV insulated cable—(£2,046 per 1,000 yds., with extra for joints, pressure test, and services of engineer, jointer and jointer's mate).—Johnson & Phillips, Ltd.

Glasgow.—Municipal Transport Committee. Accepted. Magnet coils.—Metropolitan-Vickers Electrical Co., Ltd. Roller bearings for 50 cars.—Skefko Ball Bearing Co., Ltd.; Maley & Taunton, Ltd.

Health Committee. Accepted. Kitchen and laundry equipment at Stoneyette Hospital:—Electric cooker.—Archibald Low Electrics, Ltd. (£155); Vegetable cutting machine.—Ultra Rapid Engineering Co. (£82); Potato peeling machine.—Hobart Manufacturing Co. (£71); Bread slicing machine.—William Landell (£18); Refrigerator.—J. & E. Hall, Ltd. (£179); Washing machine.—James Ritchie, Ltd. (£354); Hydro extractor.—Watson, Laidlaw & Co., Ltd. (£435).

Manchester. — Electricity Committee. Accepted. Sub-contractors for instruments and relays—Metropolitan-Vickers Electrical Co., Ltd., Nalder Bros. & Thompson Ltd.; 6,600-V substation switchgear: annual contract—Ferguson, Pailin, Ltd. Street lighting fittings—Ferranti; B.T.H. Co., Ltd. Wardle Engineering Co., Ltd.; Revo Electric Co., Ltd. Supply and laying of 33,000-V cable—Callender's Cable & Construction Co., Ltd. 33,000-V switch equipment—Ferguson, Pailin, Ltd.

Salford.—Electricity Committee. Recommended. Three transformers.—Bryce, Ltd.

Watford.—Electricity Committee. Accepted. Transformers. (500 kVA £379 and 250 kVA £217).—Metropolitan - Vickers Electrical Co., Ltd.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Airdrie.—Completion of housing schemes; burgh surveyor, Royal Buildings, Graham Street, Airdrie.

Alsager.—Water scheme (£12,000), for U.D.C.; surveyor, U.D.C. Offices, Lawton Road, Alsager.

Barwell (Leicester).—Additions to works; Architects' Department, C.W.S., Ltd., 1, Balloon Street, Manchester.

Boston.—Church, West Boston; Vicar, Parish Church, Boston.

Bradford.—Works extensions; Crofts (Engineers), Ltd.

Brechin.—Houses (22), Strachan Park; Burgh Surveyor's Office, 30, Panmure Street, Brechin.

Cardiff.—Shelters (82); city engineer.

Cheetham. — Rebuilding premises for David Jones & Co., Ltd.; T. Wainwright & Son, architects, 11, Lord Street, Liverpool.

Cheshire.—Shelters (21), Grappenhall and Thelwall; F. A. Browne, county architect, The Castle, Chester.

Chesterfield.—Domestic communal shelters; J. B. Wikeley, engineer and surveyor, R.D.C. Offices, Saltergate.

Financial Section *(Continued from page 22).*

are made for depreciation and staff pensions respectively, and it is proposed to pay a dividend of 5 per cent. (against 2½ per cent.), and a bonus of 1 per cent. (nil) on the ordinary shares. The balance carried forward is £20,921 (against £4,889 brought in).

The La Plata Electric Tramways Co. reports gross receipts for 1939 of 1,283,561 pesos, as compared with 1,376,782 pesos for 1938, and a loss on working of 2,918 dollars (against a profit of 122,145 dollars) or a loss in sterling of £445. This is increased to £10,103 by London office expenses, interest on debenture stock accrued but not paid, debenture stock redemption fund instalment accrued but not applied and renewals expenditure. In addition a sum of £8,486 has to be met for fees and costs arising from the appointment by a local Court of a syndic. After taking into account interest on investments and transfer fees, difference in exchange and credit brought in there is a debit balance of £9,205 to be carried forward.

The Electrolytic Zinc Co., of Australasia, reports that after transferring £100,000 to depreciation, the gross profit for the year to June 30th was £625,210, as compared with £584,435 for 1938–39. The net profit, after taking into account profit and loss items, including taxation, was £448,782 (against £459,524), to which is added £182,358 brought in, making £631,140 available. The total dividend for the year is 14 per cent. (against 15 per cent.), and £267,140 is carried forward.

The British Electric Traction Co., Ltd. has declared interim dividends of 3 per cent., less tax, on the 6 per cent. cumulative participating preference stock, 4 per cent. less tax (same) on the 8 per cent. non-cumulative preferred ordinary stock, and 15 per cent., less tax (same) on the deferred ordinary stock.

Burco, Ltd., report a net profit of £12,808, as compared with £24,825 for the preceding year. The dividend for the year is 12½ per cent., less tax (against 17½ per cent.).

The St. Austell and District Electric Lighting and Power Co., Ltd., has declared an interim dividend of 4 per cent. (unchanged).

The Kalgoorlie Electric Power & Lighting Corporation, Ltd., is maintaining its interim dividend at 3 per cent., less tax.

The Calcutta Tramways Co., Ltd., is again paying an interim ordinary dividend of 2½ per cent., less tax.

Meters, Ltd., is maintaining its interim dividend at 2½ per cent.

The Urban Electric Supply Co., Ltd., is paying an interim dividend of 4 per cent. (same).

Clitheroe.—Shelters (£16,000); F. Margerison, borough surveyor, Town Hall.
Extensions to abattoir; Borough Surveyor's Office, Church Street, Clitheroe.

Ealing.—Factory additions; P. Bilton, Ltd., builders, 113, Park Street, W.1.
Additions to premises, Allnatt, Ltd., builders, Chase Estate, N.W.10.

East Lothian.—Air-raid shelters at schools (£7,750); county clerk.

Eire.—LIMERICK.—Swimming baths (£20,000); J. J. Berkery, city manager.
CORK.—Temporary building at Mental Hospital (£16,000); secretary, Management Committee.
DUBLIN.—Flats, Rialto housing area; H. G. Sims, housing architect, 5, Wellington Quay, Dublin.
LONGFORD.—Houses (22), Cox and Victory sites, Killashee Street; U.D.C. surveyor.

Glasgow.—Works additions; Archibald Low & Sons, Ltd.

Hanley.—Houses, Granville Avenue; W. Leake & Co., builders, Sneyd Green, Hanley.

Hyde.—Domestic communal shelters for 7,000; J. H. Ward, borough surveyor, Town Hall.

Ilkeston.—Public and domestic communal shelters (82); borough engineer, Town Hall, Ilkeston.

Jarrow.—Shelters at the Central, Ellison and St. Peter's Schools; J. S. Weir, borough engineer.

Keighley.—Dining room, kitchen, &c.; J. P. Heaton & Co.

Art School; E. G. Felgate, borough architect, College Street.

Kettering.—Extensions to shoe factory for E. C. Gravestock, Ltd.

Loftus (Yorks).—Communal shelters (£6,376); U.D.C. architect.

London.—POPLAR.—Shelters (£15,570); borough engineer.
Warehouse; Murray & White.
Depot (£31,040); borough engineer.
SOUTHWARK.—Shelters (£14,000); borough engineer.

Macclesfield.—Deep shelters, for the Town Council; borough surveyor.

Manchester.—Offices to works; Cruickshank & Seward, architects, 16, Princess Street.
Partial completion of housing schemes (683 dwellings), Miles Platting, West Gorton, and Wythenshawe; G. Noel Hill, city architect, Town Hall.

Middlesbrough.—Air-raid shelters at 18 schools; education architect, Woodlands Road, Middlesbrough.

Morpeth.—Completion of 50 houses for R.D.C. and erection of shelters; T. T. Watson, surveyor, Howard Castle, Morpeth.

Norwich.—Alterations to Bull Close and Crook's Place kitchens, including equipment (£1,950); borough engineer, City Hall, Norwich.

Plymouth.—Communal surface shelters; J. Paton Watson, city engineer, Guildhall, Plymouth.

Rhyl.—Public shelters (20), for U.D.C.; surveyor, Council Offices, Clwydd Street, Rhyl.

Shipley.—Works extensions; Lee & Crabtree, Ltd.

Skelton-in-Cleveland.—Air-raid shelters in the Skelton and Brotton urban district; surveyor, U.D.C. Offices, Skelton-in-Cleveland.

Somerset.—Public shelters, etc. (£6,138); R. O. Harris, county architect, Park Street, Taunton.

Southport.—Domestic communal shelters (£6,500); H. L. Bunting, borough surveyor, Town Hall.

Stirling.—Communal shelters (50 persons each); Town Clerk, Municipal Buildings, Stirling.

Stratford-on-Avon.—Factory; White & Young.

Whitehaven.—Buildings for Cumberland Motor Services, Ltd.; J. S. Stout, architect, Lowther Street.

Wolverhampton.—Factory extension; Cleland & Hayward.
Factory extension; Manley & Regulas.
Factory extension, Wednesfield Road; Ford & Weston.

Worthing.—Confectionery factory; J. Whitehouse & Co., Ltd.

Yorkshire.—Adaptation of Walton Hall, with equipment (£2,500); West Riding county architect, County Hall, Wakefield.

Compensation for Damaged Goods

POLICY holders under the War Risks Insurance Scheme for Commodities are asked by the Board of Trade to assist in the speeding up of the settlement of claims. It will be remembered that one of the objects of the scheme is to encourage traders to keep their stocks at high figures and if quick compensation is not forthcoming this aim is defeated. The Board itself is speeding up the system as much as possible and policy holders can help considerably by seeing that their claims are made in proper form without delay on their part, and that in all correspondence, whether with the insurance companies or the Board, adequate and accurate details are given.

Many claims are entered based on the selling prices of goods: they should be based on the cost prices, since the scheme does not cover profits. Another cause of delay is the inclusion in claims of goods which do not come within the scope of the scheme at all; it is confined solely to stock-in-trade and no claims are eligible in connection with certain uninsurable goods, a published list of which is available.

Preventing Further Loss

There is a widespread but mistaken belief that after insured goods have been damaged, the policy holder must wait until an assessor has made his report before taking salvage measures. It is, on the contrary, the duty of the policy holder to take steps at once to prevent further damage or loss. If he is unable to obtain materials necessary for preventing further damage, he should at once apply to his local authority for assistance. If it is necessary for him, in order to avoid further loss, to incur expense in removing his goods to a place of safety, reasonable expenses for such removal will be allowed without assessment beforehand. It is also permissible to sell small quantities of damaged goods without waiting for the assessor.

As soon as the policy holder is aware that loss or damage has occurred he must inform the insurance company or Lloyd's acting as the Board of Trade's agents. Assuming the policy is valid, the insurance company or Lloyd's will at once report to the insurance official for the division in which the loss occurs. When commodities are not on the owner's own premises but are, for instance, in a public warehouse, as the owner is not likely to be the first person to know of damage or loss the duty of making this known lies with the wharfingers. They have been asked, in the event of damage to goods lying in warehouses under their control, immediately to notify the insurance official concerned direct.

Speeding up Procedure

As a further means for speeding up the procedure the Board of Trade has provided that the insurance official shall not necessarily wait for reports from the wharfingers, or indeed, from any particular person. The insurance official is required to act immediately any information comes to him from any source. Immediately he is aware of loss or damage he is required to instruct an assessor to attend and take all possible steps on the spot to avoid further damage. Insurance officials have been instructed to distribute claims as widely as possible among all the available assessors in order that one assessor in a division shall not be over-worked while another has time on his hands.

In many cases where damage or loss has occurred stock records have been destroyed, or the building itself may be inaccessible for days owing to the presence of unexploded bombs or other dangers arising from damage to the structure. The Board of Trade realises the hardship which traders may suffer through such circumstances and is doing everything it can to minimise delay. Where it appears that a period of delay is likely to be inevitable, arrangements have been sanctioned for substantial payments in advance of the final settlement.

After claims have been assessed they are sent through the insurance official to the Central Claims Department of the Board of Trade. Here they are scrutinised and sometimes questions arise before settlement can be made. Everything, however, that can reasonably be done to expedite settlement is done, and we understand that in a straightforward claim, once an assessor's report has been received, payment can usually be expected within four days.

Premiums under the scheme now exceed £40 million, which is more than those for all the fire insurance of property in the kingdom. At present the premium is at the rate of 5/- per cent. per month, but the rate is under review for the next period commencing December 3rd.

Sphere-Gap Voltage Measurement

A THEORETICAL determination of breakdown voltage for sphere-gaps forms the subject of a contribution to the *Journal of the Franklin Institute* by J. M. Meek, of the University of California. The potentials required for breakdown between spheres are calculated on the basis of the streamer theory of spark discharge. This theory is founded on atom-physical considerations, so that the calculations are not of the usual empirical nature. Agreement to within about 3 per cent. of the values determined experimentally is obtained in the case of the symmetrical sphere-gap for spacings up to a sphere diameter. The effect of variation of air density is also considered and the calculations are again found to be in close agreement with experiment. The Toepler discontinuity is explained in terms of the new theory, which predicts a transition region between two types of mechanism in the range of spacings where the discontinuity is observed, and which further accounts for the known increase in scattering of the measured potentials in that region.